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October 31, 2016

VIA ELECTRONIC FILING
Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Re: TransCanada Hydro Northeast Inc.'s June 17, 2016 and August 1, 2016 Updated Study Reports – Response to Comments
Project Nos. 1892-026, 1855-045, and 1904-073

Dear Secretary Bose:

TransCanada Hydro Northeast Inc. ("TransCanada") is the owner and licensee of the Wilder Hydroelectric Project (FERC No. 1892), the Bellows Falls Hydroelectric Project (FERC No. 1855), and the Vernon Hydroelectric Project (FERC No. 1904). The current licenses for these projects each expire on April 30, 2019. On October 31, 2012, TransCanada initiated the Integrated Licensing Process by filing with the Federal Energy Regulatory Commission ("FERC" or "Commission") its Notice of Intent to seek new licenses for each project, along with a separate Pre-Application Document for each project.

TransCanada submitted Updated Study Report ("USR") for the three projects, as required by 18 C.F.R. §5.15(f) on June 17, 2016 and on August 1, 2016 in accordance with the Revised Process Plan and Schedule for the ILP issued May 5, 2016 by the Commission. The USR meeting for both filings was held on August 25, 2016 in accordance with 18 C.F.R. §5.15(c)(3) and a meeting summary was filed August 31, 2016. In consultation with Commission staff it was determined that the comment period for studies filed on June 17 would be extended to align with the comment period for studies filed on August 1.

With this filing, TransCanada submits responses to various comments and specifically to Disagreements and Requests to Amend Study Plans regarding the Study Reports filed in the June

17, 2016 and August 1, 2016 USRs for the three projects, as required by 18 C.F.R. §5.15(c)(5). Comments, Disagreements and Requests to Amend Study Plans on the USR were filed by the following parties by September 30, 2016.

Name of Individual or Organization	Acronym Used in Comment/ Response Table
Mr. John Bruno, river abutter	Mr. Bruno
Connecticut River Joint Commissions	CRJC
Connecticut River Joint Commissions Upper Valley Subcommittee	CRJC-UV
Connecticut River Watershed Council	CRWC
Mr. O. Ross McIntyre, river abutter	Mr. McIntyre
Mr. John Mudge, river abutter	Mr. Mudge
US Fish & Wildlife Service	FWS
New Hampshire Department of Environmental Services	NHDES
New Hampshire Fish & Game Department	NHFGD
Vermont Agency of Natural Resources	VANR

Our responses are indicated in the attached table entitled, Response to June 17 and August 1, 2016 USR Comments. Some study reports will be revised in response to comments received during the comment period for the June 17, and August 1, 2016 USRs and the Commission's September 12, 2016 Study Plan Determination for studies filed May 16, 2016.

With respect to several study reports that are undergoing revisions and additional analyses we offer the following status update and revised schedule:

Studies 17 and 23 revised reports that we had hoped to file by October 1, 2016 as indicated in our August 15, 2016 Response to Comments letter have been delayed. We expect to file these reports no later than November 30, 2016.

- Study 17 – Upstream Passage of Resident Fish Species Assessment, additional analysis of 2016 Salmonsoft data and minor study revisions.
- Study 23 – Fish Impingement, Entrainment, and Survival Study, revisions based on recalculations of survival at various turbine discharges and efficiencies

Studies 10, 14/15 supplemental data and/or report errata as requested in applicable comments will be provided. We expect to file these report supplements no later than November 30, 2016.

- Study 10 – Fish Assemblage Study, additional data in Excel format related to Figure 5.4-2, percent composition of species; and minor editorial corrections.
- Study 14/15 – Resident Fish Spawning in Impoundments and Riverine Sections Study, clarified and revised data for Table 5.2-2, summary of backwater sampling periodicity and spawning observations; and minor editorial corrections

Studies 19, 22 supplemental data and re-processing of data.

- Study 19 - American Eel Downstream Passage Assessment
- Study 22 - Downstream Migration of Juvenile American Shad at Vernon

Some telemetry data associated with these studies was recently identified as potentially problematic and may have affected data associated with downstream passage route selection. This issue came to light during our review of FWS comments received on September 30, 2016 with respect to Study 21 – (Adult) American Shad Telemetry Study at Vernon. Normandeau has discovered that processing of raw data files from the Orion receivers may have mis-identified some downstream route selection results and to a lesser extent may have affected time stamps. Lotek receiver data appears to be fine. This was a data post-processing error not a data collection error. We will therefore re-process the Study 19 and 22 raw data. This is a labor-intensive task as every route selection detection record must be manually reviewed and re-interpreted. We expect to complete this task by December 15, 2106. If needed, based on the results of data reprocessing, we will then file study report revisions with correctly reprocessed data and revised downstream passage results expected to be filed by January 15, 2017. Report revisions will include the supplemental data for each study per the September 12, 2016 Study Plan Determination (SPD).

Studies 2/3, 6, 21, 25. In our response to comments we propose to prepare and file revised reports on the following studies. Final determination on our proposed revisions, modifications, or additional revisions is anticipated in the Commission's study determination letter expected on November 29, 2016, with revisions expected to be filed as follows:

By December 15, 2016:
- Study 6 – Water Quality Study
- Study 21 – American Shad Telemetry Study. The revised report will include all revised route selection and passage time results as described above, and revisions requested and summarized in the attached Response to Comments.
- Study 25 – Dragonfly and Damselfly Inventory and Assessment

By January 15, 2017:
- Studies 2/3 – Riverbank Transect and Riverbank Erosion Studies

If there are any questions regarding the information provided in this filing or the process, please contact John Ragonese at 603-498-2851 or by emailing john_ragonese@transcanada.com.

Sincerely,

John L. Ragonese
FERC License Manager

Attachment: Response to June 17 and August 1, 2016 USR Comments
cc: Interested Parties List (distribution through email notification of availability and download from TransCanada's relicensing web site www.transcanada-relicensing.com).

TransCanada Response to June 17 and August 1, 2016 USR Comments

Study 2/3 – Riverbank Transect and Riverbank Erosion Study

Comment #	Study #	Source	Comment	Response
1	2/3	NHDES	Executive Summary, p. ES-1 to ES-3: The Department requests that this section be revised as necessary to reflect the Department's comments and concerns expressed below.	Any revisions to the report will include applicable revisions to the Executive Summary.
2	2/3	NHDES	Section 4.0 Methods, p. 5: As indicated in the Department's comments submitted to FERC on 7/15/13 regarding TransCanada's updated study plans, the Department recommended that surveys should have been done more frequently (i.e., biweekly for one year). This request was denied by FERC on 9/13/13...The Department believes that the increased survey frequency may have helped to isolate the effect (if measurable) of daily operation on riverbank erosion and instability by determining if erosion occurred prior to higher flows.	The comment is noted, however, the monitoring was conducted in accordance with the approved study plan. We would disagree with the suggestion that increased frequency might have isolated the effect of project operations prior to higher flows. If by higher flows, NHDES is referring to Spring runoff, winter conditions prior to Spring thaw and runoff would have been very difficult to perform the precise field measurements that are being suggested as necessary. Furthermore, the Study plan specifically responded to stakeholder requests to respond and monitor after significant high flow events.
3	2/3	NHDES	The methods section also states the following: "Analyze hydraulic modeling data to provide information on flow velocity, stage (water surface elevation or WSE), and shear stress impacting riverbanks in the study area." The Department understands that TransCanada will review modeling data to assess whether the impacts of velocity and shear stress can be determined on riverbanks in the study area and that information will be included in the revised study report.	This data and analysis is being developed and will be included in a revised study report. Shear stress analysis (a function of velocity) will be presented in a manner similar to WSE fluctuations. We will further include a statistical analysis of the data using logistic regression as recommended in the Princeton Hydro memo (included in CRWC comment letter).
4	2/3	NHDES	Section 5.1.1 Connecticut River Valley Studies, p. 7: Examples are given where erosion has occurred in the Connecticut River upstream of the study	The sections of the river included in the referenced work are essentially free-flowing albeit not "natural" sections of the river. The upstream storage

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			area in free-flowing portions of the river and that this demonstrates two important points: "First, bank erosion can occur very rapidly on free-flowing sections of the Connecticut River and second, erosion rates can be significantly altered by localized changes in channel gradient associated with the shortening of the river at a meander cutoff." For the examples given, please clarify if flows in the free-flowing sections were fluctuated by upstream dam operation.	reservoirs (Lake Francis, 1st and 2nd Connecticut Lakes) augment flows but not in a fluctuating manner. Discharges from Murphy Dam (do not fluctuate on an hourly, sub-daily or daily basis unless responding to rapidly increasing natural inflows in the reach below the dam. The storage reservoirs do have minimum flows that sometimes sustain water levels above a changing natural flow that might otherwise occur in the free-flowing reach. Discharge from Murphy Dam also follows a maximum flow provision that is intended reduce the impact of high flow conditions in the river reach below Indian Stream. Therefore, we feel the statement is very conservative since the river reach identified is actually less variable than a natural free-flowing reach due to low flow augmentation and high flow reduction effects from upstream dam operations.
5	2/3	NHDES	5.1.2 Erosion Studies, p. 11 – 15: The following is stated on p. 11: "The shear stress acting on a bank can be increased in several ways such as through removal of the underlying support (e.g., overhanging banks), an increase in the surcharge (i.e., weight) on the bank slope accompanying precipitation or the addition of failed material from upslope, or an increase of lateral stresses that can accompany the formation of ice in cracks or water added to pore spaces." The Department interprets this to mean that water added to pore spaces in the banks associated with water level fluctuations due to project operations can contribute to erosion. Please confirm and clarify	Water added to pore spaces in the banks associated with WSE fluctuations can increase the shear stresses acting on the bank but will contribute to erosion only where that added shear stress causes the driving forces to exceed the resisting force of the bank. We would also point out that water percolating through the bank from rainfall events and during high water events, where sustained high water levels associated with natural flooding, would also add significantly more water to pore spaces and increase shear stresses on the bank. These other factors may exert a much stronger influence on bank stability as they are more likely to impact a much greater portion of the full bank height while WSE

Comment #	Study #	Source	Comment	Response
			this in the report.	fluctuations due to normal project operations would be adding water to pore spaces only at the base of the bank.
6	2/3	NHDES	5.2.3 Other Watershed Factors, p. 20 -21: The following is stated on p. 20: "On the upper Connecticut River upstream of the study area, evidence drawn from maps and field studies suggests more than 30% of the river channel was artificially straightened and is considered a primary cause for erosion today (Field, 2005)…The Department requests that, if possible, the location and length of artificially straightened channels, and the estimated percent of river channel that was artificially straightened in the study area, be provided in the report along with supporting documentation.	A revised report will add a GIS layer identifying where artificial straightening can be confidently recognized. However, straightening is more difficult to confidently identify where the floodplain is narrow as is the case for much of the study area. While straightening likely did occur elsewhere, the areas where straightening can be confidently determined will be largely restricted to the upper Wilder impoundment where the floodplain is widest.
7	2/3	NHDES	5.4.2 Repeat Monitoring, p. 42-55: The description on p. 42 of what is presented in Table 5.4.2-1 is somewhat unclear. The Department recommends that the following revisions to the first sentence of the last paragraph to help clarify (changes are in bold): "Four general conditions were observed along the transects during the two-year monitoring period: 1) bank recession at the top of the bank (in feet), 2) changes on the bank slope **(y = some change, n = no change, add = material added to that portion of the bank**), 3) loss or accumulation of bank material at the bank toe (in feet), and 4) no change (Figure 5.4.2-1 and Figures 5.4.2-2a and 5.4.2-2b)." Similarly, the Department recommends that the	We will make the recommended revisions in a revised report.

Comment #	Study #	Source	Comment	Response
			notes for Table 5.4.2-1 on p. 47 be revised as follows: "b. Values for "Top of bank" represent the amount of recession at the top of bank in feet. Notes regarding changes in bank slope for the Upper, Mid and Lower bank include: n = no change; y = some change; and add =material added to that portion of bank. Values for the "Toe of bank" represent the amount removed or added in feet with negative values representing material added to the base of the bank causing it to build out."	
8	2/3	NHDES	On p. 50, explanations for the erosion at transects 02-W03, 02-B01 and 02-B07 are provided. The explanation for Site 02-W03 is that it is immediately upstream of a meander cutoff that occurred in the 1950s and refers the reader to Figure 5.2.2-1 on p. 19. Figure 5.2.2-1, however, does not show Site 02-W03. The Department recommends that Site 02-W03 be shown on Figure 5.2.2-1 on p. 19. In addition, the explanation for Site 02-B07 refers the reader to Figure 5.4.2-4 on p. 51 however the site shown on Figure 5.4.2-4 is labeled as 02-B01. The Department recommends that this apparent error be corrected.	We will make the corrections and recommended revisions in a revised report.
9	2/3	NHDES	The last paragraph on p. 53, discusses how, at some impoundment sites close to project dams, higher project discharges occur at a lower elevation on the monitored transects because during high flow events, the WSE at the dams are lowered to reduce upstream flood elevations. The	Changes in velocity and shear stresses associated with these changes as indicated by hydraulic modeling will be discussed in a revised report. The Study 2/3 report did not find any association between the location of erosion and the magnitude of WSE fluctuations given the premise that greater

Comment #	Study #	Source	Comment	Response
			Department requests that the erosion effects of this occasional lowering just prior to high flow events (which can promote seepage causing erosion or make a bank more susceptible to erosion) be addressed and acknowledged in the report.	WSE fluctuations would lead to stronger seepage forces upon drawdown. We acknowledge in the report that such seepage forces can cause erosion but no practical way exists to precisely investigate the impact of drawdowns under high flow operations near the dam without careful measurements of seepage forces in the lower impoundment that were beyond the scope of the approved study plan. In addition, while WSE fluctuations operate on different levels of the bank at different times depending on river flows and project discharge, these variations are due to external influences on discharge and not normal project operations. For this reason the analysis of the potential impact of WSE fluctuations on bank erosion was restricted to normal project operations. Drawdown rates are also limited to a maximum of .3 feet per hour and are typically in the .1-.2 feet per hour range.
10	2/3	NHDES	On p. 54, the following is stated with regards to 4 of the 21 sites where no change of any kind was recorded: "WSE fluctuations at these sites were similar to those at sites where notching and other changes at the bank toe were aligned with the elevation range of normal project operations." It is unclear how many of the 21 sites exhibited similar conditions. The Department requests that the report include a list of the transects where notching and other changes at the bank toe were aligned with WSE fluctuations. On p. 111, it	A listing of sites exhibiting this relationship between notching and median WSE fluctuations will be included in a revised report.

Comment #	Study #	Source	Comment	Response
			appears that a total of 8 of the 21 transects had notching and other changes aligned with WSE fluctuations.	
11	2/3	NHDES	On p. 55, it is stated that a site by site analysis of WSE fluctuations was not provided and that the WSE variation associated with the 50% probability reported by the operations model during no spill conditions was considered to most closely match the typical fluctuation observed in the water level logger data. Figure 5.4.2-7 shows a sample graph created from water level logger data. The Department requests that graphs similar to Figure 5.4.2-7 (but for the entire period) be provided for all 21 transects and included in Appendix A so that one can compare the median WSE from the operations model to the water level logger data. The elevations associated with the median WSE fluctuations for each site should also be provided in Appendix A. Times when water levels were purposely drawn down prior to high flow events, should also be indicated on the graphs.	Graphs similar to Figure 5.4.2-7 for the entire period would be difficult to meaningfully display on a single page given the length of the records (two years of 15-minute data); however, we will investigate possible ways to provide this information (e.g, in Excel graphs). The elevations associated with the median WSE fluctuation under no spill conditions are already shown in Appendix A as the gray bar on the transect plots on the fourth page of each erosion monitoring site package. Times when water levels were drawn down for high flow operations will be added to the Excel graphs of water level monitoring data in a revised report.
12	2/3	NHDES	5.6.1.a Falls, p. 60 -62: On p. 60, it is stated that notching and overhangs were seen along 37% of the river's banks. It is unclear if all of the notches are at the base and within the range of elevations associated with WSE fluctuations associated with operation of the dams? The Department requests that this be clarified in the report.	Mapping data for the entire study area cannot be aligned with WSE fluctuations. Notching was mapped where present at the base of the bank but the exact elevation of that notching was not determined and cannot be aligned with WSE fluctuations. Given that the mapping occurred during no spill conditions and recorded all notches/overhangs at the base of the bank – and

Comment #	Study #	Source	Comment	Response
				largely near the water level – it can be assumed that most, if not all, of the mapped notching occurs within the range of elevations associated with normal project WSE fluctuations.
13	2/3	NHDES	5.6.3 .a Stable, p. 74-75: The following is stated on p. 75: "While stable banks exhibit none of the erosion types on the upper bank, banks with notching or low overhangs at the base of the bank were mapped as stable as long as no other erosion types or failure surfaces were present higher on the bank face." Subsequent analyses and discussions in the report are based on this definition of stable. However, as discussed on page 69, notching and overhangs are often the first step in the erosion cycle which suggests that all banks with notches or overhangs should perhaps be categorized as unstable. The Department requests that additional analyses and discussion be provided in the report that consider all banks with notching or overhangs to be unstable. This includes the analyses in sections 5.6.4, 5.6.5, 6.0 and the executive summary. As stated on p. 80, a total of 37% of the banks were observed with notching at the base with 21% observed along stable and armored banks and 16% on unstable banks. Consequently, if banks with notching are included in the unstable category for the reasons mentioned above, it could have significant effect on the results and conclusions.	We agree that the results and conclusions could be significantly affected by the inclusion of overhangs/notches in the instability category but we disagree with the premise that overhangs/notches should be included as "unstable" banks in those cases where they currently included in the "stable" category because they are included in the cycle of erosion. The cycle of erosion represents a continuum between a stable bank and an eroding bank. A minor notch at the base of the bank does not result in the rest of the bank sliding, falling, or toppling downslope. As a notch/overhang increases in size, the gravitational driving forces destabilizing the bank continue to increase until eventually the bank begins to erode. The notch/overhang is related to the destabilization of a stable bank but should not in itself be considered unstable or an eroding bank unless accompanied with other evidence. Ultimately the question is when does a stable bank become an eroding bank? For Study 2/3 that point was determined to occur when the upper portion of the bank begins to topple, fall, or slide. This reasoning is consistent with previous erosion mapping efforts both in the study area and at Turners Falls that were accepted by FERC and the Army Corps. Those studies describe and illustrate erosion as described in the Study 2/3 report and do not indicate, characterize, or illustrate erosion at any point as including banks

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				that display only notching/overhangs. For these reasons we believe a reanalysis of the data is unwarranted and would be misleading, especially in terms of comparing erosion between different years.
14	2/3	NHDES	5.6.4 Mapping Results, p. 79-80: The following is stated on p. 79: "Considering bank stability for the study area as a whole, 11% of the banks were mapped as eroding, 22% as vegetated eroding, and 6% as failing armor, resulting in a total 39% of bank length that can be considered unstable (Figure 5.6.4-2). In contrast, 61% of the banks are either stable (42%), armored (15%), or no longer eroding (i.e., healed erosion) (4%). For comparison, mapping along 85 miles of the upper Connecticut River outside of the study area found that 49% of the banks were unstable (Field, 2005)." For reasons stated in the comment above (#63), the Department requests that additional analyses and discussion be provided in the report that considers all banks with notching or overhangs to be unstable. With regards to the comparison with mapping of the 85 miles along the upper Connecticut River outside of the study area where 49% of the banks were unstable (Field, 2005) (as compared to 39% within the study area), the Department requests that the report include an explanation of how the methods between the two studies compared. If	The 49% of unstable banks mapped along 85 miles of the northern Connecticut River was categorized into eroding banks (26%) and moderately eroding banks (23%). The eroding banks were characterized nearly identically as the "eroding" category in the Study 2/3 erosion mapping in 2014. The moderately eroding category was defined very similarly to the Study 2/3 "vegetated eroding" category, although subsequent work since the 1995 study has recognized that "moderately eroding" banks may be just as susceptible to erosion as "eroding" banks despite the presence of vegetation, hence the change in the name of the category in Study 2/3 to "vegetated eroding". Notching/overhangs alone were not included in either the "eroding" or "moderately eroding" category in 2005. Because of similarities in the mapping methods between the 2005 mapping of the upper Connecticut River and 2014 mapping in the study area, the comparisons are considered valid. Additional description of the methods used in the 2005 study will be added to a revised report to make clear that the comparisons between the two studies are valid.

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			significantly different, this sentence should be deleted as its misleading by itself, or more information provided describing the differences in methodology between the two studies. Further, if 21% of the banks with notches that are currently considered stable, are instead considered unstable, then 60% (39+21) of the banks in the study area would be considered unstable (instead of 39%).	
15	2/3	NHDES	5.6.5a Spatial Variations in Erosion, p. 82-98: The second paragraph on p. 82 describes the method used to analyze unstable banks relative to other features using GIS and an erosion ratio. The Department requests that the report include more information about the methodology such as who developed it, if it has been peer reviewed, if it is a commonly accepted method used by others in the erosion field, references to the other studies that have used this method, etc. It is stated that the erosion ratio (or instability ratio) "...represents the percentage of unstable banks in the study area (or portion thereof) that were present within the specified feature (e.g., outside bend of a meander) divided by the percentage of bank length occupied by that feature…It is further stated that "Any erosion ratio above 1.0 indicates that unstable banks preferentially occur within the given feature while erosion ratios less than 1.0 indicate unstable banks are less likely to occur within the feature." Could an erosion ratio of greater than 1.0 also be	The erosion ratio was initially developed by Field Geology Services to identify potential causes of erosion in the Turners Falls Pool (Field, 2007).) and we believe it is a valid approach for the TC projects. At that time no concerns with the methodology were raised by the Connecticut River Streambank Erosion Committee and the report utilizing the erosion ratio methodology was accepted by FERC. No other studies utilizing methods similar to the erosion ratio are known. But the method relies on data that has been collected using standard geomorphological methods. The purpose of using the erosion ratio was to identify if erosion preferentially occurs within a given feature; to identify a preferential occurrence or tendency or relationship to erosion cause or effect. However, we will include a statistical analysis of the data using logistic regression in the revised study report.

Comment #	Study #	Source	Comment	Response
			interpreted to mean that there is a greater tendency for unstable banks to occur within the given feature as compared to the prevalence of that feature throughout the study area (and a lesser tendency if the erosion ratio is less than or equal to 1.0)?	
16	2/3	NHDES	The Department appreciates that Table 5.6.5-1 and Figures 5.6.5-1 through 5.6.5-4a –f, show the erosion ratio as well as the percent of total erosion within a feature and percent of feature length in the study area for comparison. In addition, the Department recommends that these graphs also show the % Erosion from Table 5.6.5-1 which is equal to the erosion length divided by the feature length… The Department therefore requests that the report also include a discussion of the % Erosion... Also, for reasons stated in comment [#63] above, the Department requests that similar analyses and discussion be provided in the report that considers all banks with notching or overhangs to be unstable. This would result in even higher % Erosion than those currently reported in Table 5.6.5-1.	The Erosion Ratio already embodies % erosion within each category within each feature type and this will be clarified in a revised report. See response to comment #13 with regard to incorporating notches/overhangs into unstable bank categories.
17	2/3	NHDES	Figures 5.6.5-3a -c on p. 85-87, show the variation in the amounts of erosion with distance from the Wilder, Bellows Falls and Vernon dams respectively. In each graph the percent of unstable banks is shown for each mile upstream and downstream of each dam. This is useful information….For reasons stated in comment	See response to comment #13 with regard to notching. An effort will be made in a revised report to include WSE fluctuation ranges on the y-axis of the graphs showing how erosion varies with distance from the dams. As well, additional narrative will be included

Comment #	Study #	Source	Comment	Response
			[#63] above, the Department requests that three more graphs at the same horizontal scale (to facilitate comparison) be developed with the y-axis equal to the percent of unstable banks per mile, where unstable banks include all banks with notching. To help determine the effects of project operation, the Department also requests three more graphs at the same horizontal time scale be developed with the y-axis equal to the WSE fluctuation range at each mile (or this information could be included on the existing graphs)…The Department also requests that the discussion regarding WSE fluctuations include an explanation (and supporting information) of the primary cause(s) of WSE fluctuations with distance in the riverine section downstream of each dam.	in the revised report as to possible explanations for variations in the magnitude of WSE fluctuations downstream of the dams.
18	2/3	NHDES	On p. 97 and 98, many statements and conclusions in this section are based on the erosion ratio. For reasons previously stated in comments above, the Department requests that this section of the report also include a discussion of the results assuming all banks with notches are unstable, and the % Erosion for each feature.	See response to comment # 13.
19	2/3	NHDES	The Department understands that TransCanada will review modeling data to assess whether the impacts of velocity and shear stress can be determined on riverbanks in the study area and that information will be included in the revised study report.	See response to comment # 3.
20	2/3	NHDES	5.6.5b Temporal Variations in Erosion, p. 98-103:	See response to comment # 13. Furthermore, while

Comment #	Study #	Source	Comment	Response
			For reasons stated in comment [#63] above, the Department requests that similar analyses (as shown in Tables 5.6.5-2 and 5.6.5-3 and Figure 5.6.5-5) and discussion be provided in this section of the report that considers all banks with notching or overhangs to be unstable. Although on p. 99 it is stated that "...notching alone would unlikely have been considered as eroding in 1955 or 1978...", there is no hard evidence indicating that notching was not considered unstable in earlier studies…	the percent of erosion would show an increase in erosion over time if notching was included, the report's conclusion that erosion has decreased through time is corroborated by historical aerial photographic analysis which is completely independent from the bank stability mapping. Photos included in erosion mapping of 1958 show bare banks that would be associated with the "eroding" category. If notching was included as eroding in earlier mapping efforts then some of the photographs would have shown only notching but this was not the case.
21	2/3	NHDES	5.6.5c Rates of Erosion, p. 104 – 106: For reasons stated in comment [#65] above, the Department requests that similar analyses and discussion be provided in the report that considers all banks with notching or overhangs to be unstable.	See response to comment # 13.
22	2/3	NHDES	5.8 Hydraulic and Operations Modeling, p. 106 – 107: The discussion on p. 107, states the following: …"As a result of lowering WSE at the dams, a convexity in the longitudinal profile develops at the lower end of the impoundments (Figure 5.6.7-1) that could potentially engender a channel response as a stable river profile typically has a concave-up profile in contrast to the observed convexity. Similar convexity and rapid gradient changes result where flow releases from an upstream project entering a downstream impoundment encounter lowering water in the receiving impoundment." [This] suggests that high water drawdowns can	A revised report will include further discussion on the frequency and potential impact of drawdowns on erosion. See response to comment # 13 with regard to inclusion of notching/overhangs.

Comment #	Study #	Source	Comment	Response
			have a significant impact on erosion and should be further explained. The Department requests that this section of the report include the frequency of the high water drawdowns at each project, and a discussion of how such drawdowns can influence and potentially cause or, make a bank more prone to, erosion.	
23	2/3	NHDES	Throughout this section [Section 6.0] (including the "Conclusions") the potential for project operation to cause or contribute to erosion by making riverbanks more susceptible to erosion, appears to be downplayed. For example, on p. 114, the following is stated: "Furthermore, the approximately 40% of bank instability mapped through the study area is similar to more free-flowing portions of the Connecticut River (Field, 2005), so normal project operations cannot be considered to be a cause of excessive erosion." The Department requests that this be revised to include language such as the following: "Furthermore, the approximately 40% of bank instability mapped through the study area is similar to more free-flowing portions of the Connecticut River (Field, 2005), which suggests that normal project operations may not be a direct cause of excessive erosion, although such operations likely contribute to erosion by making banks more prone to erosion due to seepage forces associated with daily fluctuations." A similar acknowledgement of the potential for project operations to cause or contribute to	The revised report will include language similar to that recommended in the comment.

Comment #	Study #	Source	Comment	Response
			erosion by making riverbanks more susceptible to erosion should be added to the second paragraph (beginning with "Fluctuations in WSE...") on p. 111 and at the end of the first paragraph (beginning with "... on the cycle of erosion...") on page 115.	
24	2/3	NHDES	On p. 112, the following is stated: "Study 6 – Water Quality Monitoring Study (Louis Berger Group and Normandeau, 2016a) found that the Wilder, Bellows Falls, and Vernon projects had negligible to no effect on turbidity, with recorded values remaining generally very low and within state water quality standards. The few recorded spikes in turbidity were found to occur in response to high flows resulting from heavy rain events." It should be acknowledged that turbidity meters were not located near shore, as requested by the Department on 7/15/13, so local effects (i.e., near-shore turbidity plumes due to project operation) were not measured.	The comment is noted. In the February 21, 2014 Study Plan Determination FERC determined nearshore monitoring of turbidity would not necessarily result in additional useful information because Studies 2, 3, and 8, supplemented with turbidity data collected in Study 6, would provide sufficient information to ascertain the causes, including project operations, of rates and circumstances of stream bank erosion. Furthermore, Study 14/15 included measurements of turbidity at nearshore spawning sites. These data showed only 17 of 247 (6.5%) turbidity readings > 10 NTU. Of those, only 11 readings (4.5%) were > 20 NTU and only 2 (<1%) were greater than 30 NTU, indicating that near shore turbidity does not seem to differ from the turbidity readings taken in Study 6 nor are they discernible from the relatively small water surface fluctuations from project operations. The turbidity collected through the 2015 study year in Study 6 indicate that turbid conditions occurred infrequently and episodically during high flow events outside the projects' normal operating conditions. Therefore, we agree with the Commission's determination that additional nearshore turbidity measurements as part of Study 2/3 would not provide any additional information that would

Comment #	Study #	Source	Comment	Response
				materially change study conclusions. We note that regardless of the amount of erosion that currently occurs, the continuously monitoring sondes used in Study 6 did not detect large occurrences of erosion (inferred from turbidity), indicating that the current amount of erosion does not impact water quality. Turbidity is commonly thought of as measuring water clarity, which people think of cloudy water due to inorganic grains (clay/silt) but this is not always the case. Turbidity is a measure of the amount of light scattered by particles. The particle could be algae, debris, sediment, tannins. It is possible to have unclear water that has little suspended sediment.
25	2/3	VANR	The study did a complete and thorough document[ation of] the presence of erosion over a large geographic area, as well as repeat surveying at 21 monitoring transects, and in general characterizing the processes of erosion that potentially contribute to erosion in the project affected area. However, the study was not able to meet the goal of ascertaining the likely causes of erosion in the project affected area. The Agency acknowledges erosion is a natural process, and that erosional processes may act in concert with one another. Additionally, the causal agent of erosion likely varies on temporal and spatial scales, and likely operates on a time scale greater than two years, as acknowledged in the study report. The concern is by the study not meeting the goal of ascertaining the likely cause of erosion,	We appreciate the comment and believe the study demonstrates that for large portions of the study area, particularly Bellows Falls and Vernon impoundments, the rate of erosion has declined through time while the projects have operated largely as they do today. Some increase in the erosion rate has occurred in the upper Wilder impoundment where project operations controlled at the dam have minimal impact compared to upstream inputs. The revised report will provide additional information to document that project operations have changed very little over several decades. Site-specific causation studies were beyond the scope of the approved study plan.

Comment #	Study #	Source	Comment	Response
			the Agency is not able to determine whether the rate of erosion in the project affected area is being accelerated by project operations which could potentially impact water quality and other aquatic resources. The study employed several methods for monitoring and analyzing erosion over a wide geographic area for the limited time of two years. Whether the methods or analysis employed by the study are adequate in identifying the likely causal agent of erosion at a particular site should be determined. If the methods, analysis or limited time period study are deemed to not provide the necessary information to meet this goal, the Agency recommends that discussion be added to the report identifying the methods and the time need to ascertain the likely causes of erosion at particular sites in the project affected area.	
26	2/3	VANR	The study report indicates that analysis would use outputs from the hydraulic model (Study 4) to provide information on flow velocity, water surface elevation, and shear stress impacting the riverbanks in the project affected area. However, the study report only presents information and discussion on the analysis for the water surface elevation, and not on velocity or shear stress which are provided in an appendix without discussion. Additionally, the study report does not use a correlation analysis to assess project affects as stated in the September 13, 2013 revised study plan for Study 2…	See response to comment # 3.

Comment #	Study #	Source	Comment	Response
			The Agency recommends that the shear stress and velocity analysis and how these variables are affected by project operations based on information provided by the hydraulic model be presented and discussed in the study report as described in the revised study plan.	
27	2/3	VANR	Section 5.4.2 Repeat Monitoring – The sections states that, "Normal project operations result in daily or sub-daily fluctuating water levels. At many sites, the position of those daily fluctuations on the bank aligns with the location of notching at the base of the bank (Figure 5.4.2-6 and Appendix A)." …The formation of a notch at the base of the bank was observed at about half of the 21 monitor sites over the course of the study which coincided with the range of water level fluctuation from normal project operations. This daily to sub daily change in water level on the bank seem[ing]ly would cause changes in the pressure on the bank resulting [in] the potential to accelerate the erosional process at these particular sites. The Agency recommends that further assessment be conducted on the sites where notching occurred at the normal operating level by evaluating existing data, including but not limited to sediment layer of the bank to provide more information on causation of the erosion.	Further analysis of the monitoring sites will be conducted but unfortunately the stratigraphy of the bank at many monitoring sites was thickly covered with material eroded from upslope so details regarding heterogeneities of bank sediments at the base of the banks may not be available at many sites.
28	2/3	VANR	Section 5.6.5a Spatial Variations in Erosion – On page 98 of this section, the report states, "A number of other similar analyses comparing	See response to comment # 3. We believe that shear stress/velocity (1D average mid channel) in addition to statistical analysis (see response to

Comment #	Study #	Source	Comment	Response
			erosion with potential causal factors are possible with the GIS data provided in Appendix C such as determining if erosion preferentially occurs upstream of valley constrictions, adjacent to tributary confluences, near sites of bank armoring, where changes in water-surface slope are greatest, or where shear stress is highest. However, a complete and exhaustive analysis of all possible relationships was beyond the scope of this study." The Agency disagrees that analyzing the potential causal factor for erosion is beyond the scope of this study, in fact it is an objective of the study. The Agency is not asking for a complete and exhaustive analysis, however several causal factors specified in the revised study plan are not addressed in the report…The study goals as stated in the revised study plan…indicate that shear stress would be analyzed and additionally the plan for study 3 states, HEC-RAS one-dimensional (1-D) hydraulic modeling is being completed of the entire study area as part of the Hydraulic Modeling Study (Study 4). HEC-RAS modeling will provide information on flow stage, velocity, and shear stress, important factors in the erosion process. The Agency requests that all analysis that were identified in the Revised Study Plan be completed including the use of correlation analysis methods and additionally the use of data from the River 2D reaches of river (Study 9).	comment #3) will be adequate to assess these factors to the extent that they can be assessed. With regard to River 2D modeling, the study plan suggested that if necessary 2D modeling would be conducted at up to 6 of the monitored 21 sites if those sites were complex sites where HEC-RAS modeling does not adequately describe them (e.g., eddy flows or flow deflections). Based on the results of site monitoring, we do not believe this analysis is needed or would contribute additional useful information.
29	2/3	VANR	Section 5.8 Hydraulic and Operations Modeling –	See response to comment #3.

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			This sections states that, "For Study 2, the hydraulic modeling data were used to establish the WSEs for flows of varying magnitude at each of the 21 monitoring sites (Appendix A)." The methods section of the study report (Pg. 5) indicated that this analysis would include flow velocity and shear stress. It is unclear from this section whether a thorough analysis for velocities and shear stress were performed at the 21 monitoring sites. If the analysis was not completed as part of the initial study, the Agency request that it be completed and presented in a revised study report.	
30	2/3	CRWC	TransCanada should incorporate hydraulic modeling results from Study 4 into Study 2 -3, and analyze the results to assess the relationship between shear stress and riverbank erosion, as proposed in the RSP.	See response to comment # 3.
31	2/3	CRWC	TransCanada should revise Study 2 and Study 3 to identify the effects of shoreline erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, and aquatic and terrestrial wildlife habitat, as stated in the RSP.	Analysis of shear stress that will be completed and included in the revised study report, together with maps which depict erosion together with locations of other resources will illustrate relationships (if any and if discernible at the scale of erosion mapping) between erosion and other resources
32	2/3	CRWC	FERC should consider the August 1, 2016 Study 2 – 3 report to be the interim report and that the Erosion Working Group's current review of the Combined Study 2 -3 be integrated into a revised study that the Erosion Working Group is then able to review as the final study, as proposed in the RSP… TransCanada should formally meet with the	The August 1, 2016 report is considered the initial study report intended for stakeholder review and comments. The report will be revised to provide additional data and analysis, and needed clarifications as applicable and based on stakeholder comments. Should a working group meeting be needed to help clarify aspects of the report we will

Comment #	Study #	Source	Comment	Response
			erosion working group as necessary to consider its comments and revise Study 2- 3 report to reflect those comments, as proposed in the RSP.	schedule such a meeting.
33	2/3	CRWC	TransCanada should extend the cross-section monitoring beyond the two-year monitoring period proposed in the RSP given that the Study itself suggests that this period was not long enough to analyze the *"cycle of erosion"* at all sites. This is a conclusion that is a product of the RSP so the fieldwork should continue until TransCanada collects sufficient data to measure erosion changes over time.	The two-year monitoring period followed the approved study plan and constituted a measurable "snapshot in time". The monitoring at select sites, along with historical comparisons and riverbank mapping conducted in 2014/2015 collectively have led to and supported conclusions related to extent and rate of erosion over time.
34	2/3	CRWC	TransCanada should analyze how water surface elevation (WSE) fluctuations increase the vertical range on the bank exposed to additional erosive forces such as boat waves, piping, and ice jams, that are all issues identified in the RSP.	Normal project operations result in decreased (not increased) vertical fluctuation range on the bank relative to high flow operations and flood events. While WSE fluctuations operate on different levels of the bank at different times depending on river flows and project discharge, these variations are due to external influences on discharge and not normal project operations.
35	2/3	CRWC	TransCanada should revise the report and present an analysis of the effects of the differences in the gradient of ground water and WSE changes.	See response to comment #44 below. Such an analysis was beyond the study scope of the approved study plan and we continue to believe that such an analysis will not add appreciable information beyond what we have ascertained with methods approved in the study plan..
36	2/3	CRWC	TransCanada should re-evaluate the existing data with respect to these important factors (i.e., methodology used, groundwater elevations, and surrounding land use) to "ascertain the relative importance of water-level fluctuations associated with project operations in the erosion	We note that the Study 2 study plan was related to the 21 monitoring site only, not to the entire river within the study area, which was the topic of Study 3. While the report for both studies was consolidated, the goals and objectives for each study differed.

Comment #	Study #	Source	Comment	Response
			process relative to other contributing factors" as per the RSP (page 21, RSP Study 2).	Effort was made to determine the relative importance of various factors through the use of the erosion ratio. A determination of groundwater levels and careful mapping of all land uses along the river were beyond the scope of the study.
37	2/3	CRWC	TransCanada should revise the report to add data supporting their claim that "normal project operations that have changed little in several decades" that appears in the last paragraph in the report.	The current licenses were issued in 1979. They specified minimum flows and required that operating procedures be developed for high water that provides for coordination with USACE dams. Those have been followed consistently and similarly since the licenses were issued. Flowage rights acquired in years prior to the current license have not been expanded and as a result continue to restrict reservoir elevation operating ranges. The only potential change that might affect operations would be the significant increase in minimum flows from upstream projects that in effect would likely reduce the average level and frequency of fluctuation in the downstream projects undergoing relicensing. The revised report will provide additional information to support our claim that operations have changed little in several decades.
38	2/3	CRWC	TransCanada should revise the report and formulate correlations between riparian buffers and erosion sites. TransCanada response dated 6/1/2016 to the comments on Study 1 (submitted March 1, 2016) stated, "Study 3 will include data on presence or absence of riparian buffer on most recent aerial photographs and relate it to erosion	This information is in the initial study report, and incorporated into the erosion ratio table (Table5.6.5-1) in the report. A figure similar to others comparing various features with erosion will be added to the revised report for additional clarity. The data do not show that erosion preferentially occurs where riparian vegetation is absent.

Comment #	Study #	Source	Comment	Response
			mapped in 2014; however, such an analysis was beyond the approved scope of Studies 1-3." Stakeholders expected this analysis to be part of the study.	
39	2/3	CRWC	TransCanada should modify Studies 2-3 as otherwise detailed in the attached Peer Review [i.e., "the Princeton Hydro review"].	Those additional comments that are within the study scope will be addressed in the revised report.
40	2/3	CRWC	These studies were supposed to be a package of information that would show the history of erosion at all three projects AND show an analysis of causation of the erosion along the entire reach of river affected by the projects. That is not what the project owner presented to the stakeholders with these studies.	TransCanada analyzed potential causes related to erosion by comparing occurrences with erosion relative to other features throughout the study area by using the erosion ratio. A detailed site-specific analysis of a given cause of erosion at any specific location was not the purpose of the studies and beyond the scope of the approved study plan.
41	2/3	CRWC	Throughout the conversations of plan development/revision/review TransCanada knew that CRWC and other stakeholders wanted an analysis that lead to a conclusion of either none/partial/full responsibility on the part of TransCanada operations relative to flows and WSE as a cause or partial cause of erosion. The stakeholders thought the experts were supposed to design a plan that got us there and yet the Study 2 -3 report avoids providing any answer to the basic, often stated, clear, and consistent question from the stakeholders. The statement in the goals of Study 2 framed our expectations: "*whether water level fluctuations, described in terms of magnitude, periodicity and duration, and increased shear stresses resulting from project operations are correlated with erosion in project-affected areas."*	We have shown through the application of erosion ratios that erosion does not preferentially occur where WSE fluctuations are the greatest. The revised report will include a similar analysis with respect to shear stress.

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42	2/3	CRWC	TransCanada declined conducting geotechnical slope analysis for this study because they considered it premature and related to mitigation. CRWC disagrees and believes that geotechnical slope analysis would be an effective tool for analysis to fulfill objectives of the study: characterize the processes of erosion, and ascertain the likely causes of erosion. If we are to have mitigation discussions later in the ILP process, we will have no geotechnical data that may guide these discussions. An added observation about this mitigation claim is that no one, neither FERC, the company, nor the stakeholders has had one word of discussion about mitigation for project effects and as near as CRWC can tell there is not time identified in the ILP schedule when those discussions might take place. We seem to be saving this discussion for a forum that has not and may never materialize.	Geotechnical investigations were beyond the scope of the approved study plan and would provide only site specific information that would be difficult to extend more broadly across the study area. Geotechnical investigations would not materially add to meeting these objectives, would not take into account the collective nature of other contributing factors that can and do affect erosion, nor be likely to change the overall study results.
43	2/3	CRWC	There is no correlation of erosion with land cover despite specific mention at two of the stakeholder meetings that land use and the lack of riparian zones are part of the cause of erosion. TransCanada noted that, "a GIS line file was created for the presence or absence of riparian vegetation by hand-digitizing the locations of riparian vegetation as viewed on 2010 digital orthophotographs available through NH Granit (Web citation 8)," but there is no analysis and correlation between problematic land uses and erosion sites creating another blank in the analysis of erosion causation.	See response to comment #38.

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44	2/3	CRWC	The study claims that the "magnitude of water surface fluctuations in the study area is less than 2 ft. for 75% of the study area's length, so hydraulic gradients between groundwater levels in the bank and the adjacent river level are likely small... However small the gradient might be, it was incumbent on TransCanada to evaluate the effect of piping as the expression of the difference in gradient in creating the first stage of erosion, water edge notches…TransCanada should revise the report and analyze the effects of the differences in the gradient of ground water and WSE changes (pg ES 3 Study 2-3)…CRWC requests that TransCanada document their claim that the 2 ft. difference has only a small effect. This does not square with Study 3 goal to *"ascertain the likely causes of erosion (e.g., high flows, **groundwater seeps,** eddies, **water level fluctuations** related to project operations),"…*	To put seepage into appropriate context, the report states (p. 111): "the rate of seepage, and the resulting rate of erosion [emphasis added], depends on the hydraulic gradient between the groundwater levels in the bank and the WSE of the river." And, "furthermore, the location of erosion does not preferentially occur where the magnitudes of WSE fluctuation are the greatest and the resulting seepage forces would be highest [emphasis added]. The mention of the low hydraulic gradient was meant to provide a possible explanation for why no preferential erosion is occurring in low gradient areas. The study findings show that the location of erosion does not correlate with locations where WSE fluctuations are the greatest and where seepage forces are expected to be greatest.
45	2/3	CRWC	With regard to Aquatic Habitat, the Study 2-3 report references Study 8 but acknowledges that the Study 2-3 did not quantify the effect of fine-grained riverbank materials on increased embeddedness of coarse-grained spawning substrates in the project reservoirs… TransCanada should continue gathering and analyzing data to determine the effects of project operations on the loss of aquatic habitat.	The locations of erosion were identified as part of Study 3 but the fate and transport of that sediment was beyond the scope of the study other than at the 21 erosion monitoring sites which documents at some sites its downslope movement to the base of the bank and its removal from the base of the bank. Determination of the effects of project operations on the loss of aquatic habitat is outside the goals of these studies.
46	2/3	CRJC	TransCanada did an exemplary inventory of existing bank erosion within the study area, but its conclusions based on too few transects over only a two-year interval are speculative, and its	We appreciate the comment relative to the effort expended as part of this study. The number of transects and length of monitoring were conducted according to the approved study plan. The

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			questionable assumptions in an unorthodox methodology to ascertain the causes of erosion make their conclusions equivocal. Nevertheless, the technical studies and analyses conducted by TC do appear to affirm that project operations contribute to bank erosion within the project boundary. However, the crucial question of the proportionate contribution of project operations to that erosion, the impact on specific natural and human resources, and the economic cost of these impacts have not been determined.	methodology for ascertaining causes was the same as used during a study of Turners Falls Pool that was accepted by FERC and at the time of its review no stakeholder comments were made concerning the methodology. However, further statistical analysis will be included in the revised report in an effort to distinguish proportionate contribution of various causal factors (see response to comment #3).
47	2/3	CRJC	We endorse the erosion peer-review comment letter by Princeton Hydro that critiques the erosion studies [see CRWC comments]…The most important goals and objectives of the approved study were not met with the approved study methodology. This is, in part, due to the fact that the approved studies were not conducted as provided for in the approved study plan; but, also due to deficiencies in the proposed methodology itself.	The methodology outlined in the approved study plan and goals that drove the methodology were accepted by FERC. Comments made in the Princeton Hydro report and embodied in CRWC's comments above will be addressed to the fullest extent feasible in the revised study report.
48	2/3	CRJC	The CRJC applauds the comprehensive inventory of erosion sites that was compiled by the Studies. However, we are disappointed that the potential impact of this erosion on natural (Study 27, Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats), and historic resources (Study 33, Archaeological Phase II Technical Report Determination of Eligibility), and the portion of the impact attributable to project operations have not been determined. These resources need to be protected, to the extent practicable, from loss by	We appreciate the comment relative to the comprehensiveness of the study. With regard to erosion effects on other resources, see response to comment #31.

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			erosion and from rapid watering and de-watering of habitats.	
49	2/3	CRJC-UV	Throughout the report, reference is made to "normal project operations," yet on page 107 mention is made of activities which result in flows outside normal operating ranges. If "normal project operations" are not the same as actual project operations, is it the right scenario for evaluating the effects of fluctuating water levels on riverbank erosion? Similarly, it is noted on page 106 that the median fluctuation was used for the erosion studies, not the extremes, which would reflect the actual operations and be associated with higher impacts. To evaluate permit conditions in the future, it will be necessary to compare the impacts under today's permitted pool fluctuation and an alternative with a smaller range.	The term "normal project operations" is used to distinguish operations within the generating capacity of each project (e.g., minimum flow to maximum generating capacity) from "high flow" operations related to spill flows. TransCanada cannot control flows higher than generating capacity and passes those via the spill gates at each project. In preparation of high inflows that exceed generating capacity, TransCanada may lower water elevations at the dams to accommodate those inflows in accordance with the current licenses and agreement with the US Army Corps of Engineers to minimize flooding. That lowering and then rising of water levels resulting from high flows are not considered normal project operations. The median fluctuation was consistent with water level data from monitoring sites and because of its frequent occurrence over time was taken as a fluctuation level that might be closely associated with the occurrence of erosion
50	2/3	CRJC-UV	On page ES - 1 it is stated that nearly 40% of the riverbanks in the study area were mapped as unstable, yet on page 79 it is reported that 11% is eroding, 22% is vegetated eroding, 6% is failing armor, 15% is armored and 4% shows healed erosion. This totals 58%. Surely it can be assumed, given the cost and permitting required, that little if any of the 15% that is armored was done so	The report (p. ES-1 and throughout, specifically Section 5.6.3) uses the term "unstable" to include areas categorized as eroding, vegetated eroding, and failing armor (or 39% of the total). Armored and healed erosion categories were not considered to be unstable; however, the report recognizes that areas mapped as stable presently may have been eroding in the past (healed erosion) or could erode in the

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			without evidence of erosion.	future (armoring that fails later) as corroborated by the comparison of erosion maps from different years that show considerable change in the location of erosion over time. On page 83, the report discusses preventive armoring as the likely explanation for the presence of armoring on inside bends rather than outside bends as would be expected in an unaltered river. Armoring locations in the study area indicate purposeful historical river alterations and straightening, rather than armoring in reaction to erosion (which also occurs along shorter bank sections).
51	2/3	CRJC-UV	Throughout the report the Vernon impoundment is referred to as having decreased 8%, yet on page 110 it is stated that "Changes of less than 10%...should be considered within the margin of error given the discrepancies in mapping …" This means that it is not appropriate to talk about Vernon as having a decrease in erosion as 8% is within the margin of error.	The commenter's point is valid, but a decrease in erosion rates is further corroborated by the analysis of historical aerial photographs.
52	2/3	CRJC-UV	Boat waves are noted as having the potential to impact erosion more than water level fluctuations, and this reasoning is used to partly explain the increase in erosion rates at the Wilder Dam, yet few motor boats are found very far above the Wilder Dam due to limits on wake speed in the narrow upstream river stretches. Motor boats are far more prevalent on the more southern segments of the river where erosion rates are	We respectfully disagree and note that the study report did not characterize boat wakes (or waves) as a major cause of erosion, but rather placed them into context with other potential causes of erosion. "Boat waves have the potential to exert a greater erosive force directly on the banks compared to WSE fluctuations" (p. 111); and "If boat waves and WSE fluctuations were the only erosive forces acting in

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			reported to have declined.	the study area, erosion would continue for only a certain length of time following a significant change in impoundment level or project operations before the banks, protected by the growing beach faces, would stabilize" (p. 112). However, the report did state that others have considered boat wakes to be important: "In impoundments, wind and boat waves have been identified as a cause of erosion (Gatto and Doe, 1987; Porter, 1993)" (p. 14); and "Boat and wind waves have been considered an important cause of erosion in the study area (Simons et al., 1979) and other localities (Gatto, 1982; Lawson, 1985; Porter, 1993)." (p. 111).
53	2/3	CRJC-UV	The Report seems to rely on the fact that since spring floodwaters carrying away the eroded bank material prevent bank stability and enable the cycle to continue, this makes other factors insignificant in the process. However on page 11 of the report it is noted that when a bank is at the threshold of failure, a slight increase in sheer stress or slight decrease in strength can lead to failure. On page 109 it is stated that the sediments in this area are particularly prone to erosion and as a result minor changes have the potential to initiate erosion. The conclusion that the largest factor in riverbank erosion on the Connecticut River is flooding was supported by the Connecticut River Streambank Erosion Study Massachusetts, New Hampshire and Vermont performed for the U.S. Army Corps of Engineers in 1979. However no attempt was made in Studies 2 and 3 to analyze the proportion of bank erosion which would occur	The other processes are not insignificant, but they cannot continue without the transport of material away from the base of the bank. The commenter's points are valid that banks are close to threshold of erosion and lower fluctuations could provide some control of bank erosion. However, the data do not show a strong association of erosion and WSE fluctuations suggesting WSE fluctuations are not a major threshold crossing perturbation that creates a strong signal in the broad patterns of erosion throughout the entire study area. This does not discount that certain areas may be particularly sensitive to changes but the data set collected along 250 mi of bank is not refined enough to characterize all of the potential driving forces and resisting forces acting on the bank at any particular point. The Army Corps study included the Turners Falls impoundment in its analysis where WSE fluctuations are much greater and where the benefits of limiting pool

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			with only spring flooding vs bank erosion plus spring flooding. The ACOE study determined that while flooding is the most significant cause of erosion, some control of bank erosion could be achieved by limiting the pool fluctuations associated with hydropower development (Executive Summary).	fluctuations were most likely to accrue. With regard to the ACOE report, the quoted statement in the Executive Summary reads in full: "Furthermore, limited control of upper bank erosion can be achieved by limiting pool fluctuations associated with hydropower development and by limiting the amount of river traffic, particularly high speed pleasure craft. ***However, adoption of such measures will not eliminate major bank erosion that may occur during periods of flooding.***" [emphasis added]. Page 160 of the ACOE report provides additional characterization of pool (impoundment) fluctuations: "…the presence of pools reduces bank erosion on the order of 34 percent compared to the natural river…[reductions in pool fluctuation of 50 percent] will reduce the bank erosion on the order of 7 – 9 percent… pool fluctuations at most contribute approximately 18 percent of the bank erosional forces. .. much smaller than…the 34 percent increase in bank stability due to reduction of shear stress in the pools as compared to the natural river. Hence a total elimination of hydro-pool fluctuations will not eliminate bank erosion…"
54	2/3	CRJC-UV	On pages 110-111, the Report describes how raising the water level, as was done in 1950 with construction of the Wilder Dam, "creates an unstable situation that leads to bank failure," yet with no explanation goes on to state that the increased rate of erosion is more likely due to natural inflows.	Pages 110-111 of the study report explains erosion due to inflows as follows: "The apparently increasing rate of erosion in the upper Wilder impoundment (Figure 5.3-1a) is more likely related to upstream inflows than Wilder project operations. The upper Wilder impoundment is closer to the McIndoes project than to Wilder dam. Therefore, McIndoes

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				inflows along with significant natural discharges likely have a greater impact on erosion rates in upper Wilder impoundment than Wilder project operations."
55	2/3	CRJC-UV	Although the applicant's consultants cite the Connecticut River Erosion Inventory performed by the Grafton County Conservation District (Kennedy et al. 1992), it appears that none of the statistical data or site-by-site photographic evidence contained in that Inventory were used in Studies 1, 2 or 3. This data could change both the erosion percentages outlined above, and the conclusions reached in the current studies.	Given the difficulties in comparing erosion studies through the decades a decision was made to try and limit these difficulties by only comparing studies completed over the entire study area by a single entity and over a short timeframe (within a single field season). The scope of the study prevented analyzing all erosion studies available (TC itself has erosion maps for almost every year since 1958). This does not mean that the erosion inventories conducted by Kennedy et al. are without merit but we do not believe that incorporation of that data would materially change the results of the study
56	2/3	Mr. Bruno	The methodologies utilized to determine the historical erosion limits were not sufficient to accurately determine how much erosion has historically occurred. I question the accuracy of determining the historical bank locations from old aerial photography and mapping… I do not believe the resolution in these photos is sufficient to accurately measure historical rates of erosion using the Study 1 methods.	The methodologies used in Study 1, and in Studies 2 and 3 were approved by FERC in their September 13, 2013 Study Plan Determination. The resolution of the georectifying process is coarse, as discussed in the report but some reliable broad conclusions can still be drawn from the analysis (e.g., rate of erosion in lower Bellows Falls impoundment has declined through time), especially where supported by other data sources.
57	2/3	Mr. Bruno	Two year observations along with the small number of transects are not sufficient to draw conclusions related to…the extent (rate) of erosion in the study areas. Erosion occurs and continues over years.	See response to comment # 33.
58	2/3	Mr. Bruno	The study claims that boat wakes are a major cause of erosion…the few number of boats over	See response to comment # 52.

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			the relatively short boating season would not have the effect on erosion that the studies represent.	
59	2/3	Mr. Bruno	Although the intent of the studies was to determine the causes of the erosion in the study area and the studies do identify the potential causes there was no technical data collected, prepared or analyzed to provide any conclusion as to the degree of erosion as it is related to the potential causes.	The study attempts to demonstrate which potential causes and river characteristics are associated with greater rates of erosion. The factor that best explains the locations of erosion is bank height and composition. This is not to say other factors and causes are not important but those other attributes are not associated with greater concentrations of erosion. Considerable technical data from erosion monitoring surveys, GIS-based mapping of erosion and river characteristics, hydraulic modeling, and georectifying of historical aerial photographs went into the analysis. The revised report will also include further analysis to determine if shear stress and velocity is related to erosion locations.
60	2/3	Mr. Bruno	None of the studies conducted any geotechnical or hydrogeological studies (analyses) to determine the effects of the operational water elevation fluctuations on the riverbank erosion. This would be the only way to determine the effects of water elevation fluctuation on streambank erosion.	FERC's September 13, 2013 Study Plan Determination did not require geotechnical analysis (p. B7): "Such an analysis could be useful in designing an embankment for a site-specific mitigation measure. However, because mitigation proposals and designs are premature at this stage of the licensing process, it is unclear how the requested information would inform potential license conditions."
61	2/3	Mr. Bruno	[The study] utilized a ratio method [which] is not an accepted Standard or an accepted Methodology. There are accepted modeling methods and procedures for determining bank erosion, i.e. Bank and Toe Erosion Model from the USDA.	See response to comment # 15. We also note that the Bank and Toe erosion model mentioned is for site-specific analysis and for a snapshot in time. The method establishes shear stresses based on bank geometry so cannot establish stresses associated with seepage forces that might be created by WSE fluctuations. The

Comment #	Study #	Source	Comment	Response
				model is developed for an un-impounded river and is thus not adequate for Study 2/3 analysis
62	2/3	Mr. Bruno	One of the conclusions of the report is that TransCanada's operation and water level fluctuation is not the major cause of the riverbank erosion. I find this hard to believe since boat traffic and ice only occurs over a relatively short period while the water level fluctuation occurs 24/365, i.e. 24 hours a day 365 days a year even under the ice during winter…The report's conclusions are based on observations rather than facts and technical analysis.	We note that the report concluded that flood flows, rather than boat waves or ice, or normal project water fluctuations appear to be the primary cause of erosion: "Flood flows are primarily responsible for the removal of sediment from the base of the bank that accumulates from the slides, flows, and topples resulting from the notches and overhangs forming at the base of the bank. Tractive forces generated by flood flows are the only mechanism capable of removing the sediment from the base of the bank that otherwise would lead to bank stabilization if not removed. While other processes such as waves or seepage forces created by project-related WSE fluctuations may exert some control on the cycle of erosion, they cannot be considered as resulting in excessive erosion" (pp 114-115).

Study 4 – Hydraulic Modeling Study

Comment #	Study #	Source	Comment	Response
1	4	CRJC	TC should incorporate into the hydraulic and operations models scenarios of more intense storm events and prolonged periods of drought that are based on recent historical data and predicted by the preponderance of climate models.	We note that the hydraulic model (Study 4) does not model events but instead, characterizes WSEs based on flow and water surface elevation at the dams. The concept of modeling hypothetical climate change to hydrologies was discussed during study plan development, and we continue to assert that this is not reasonable and it was not recommended by FERC in their September 13, 2013

Comment #	Study #	Source	Comment	Response
				Study Plan Determination.
2	4	VANR	The report states, "Calibration was conducted across a range of flows over a period of about 5 to 7 days in 2014 for one typical operations event and one spill event." Please describe what was considered "typical" operations for the purposes of model calibration. Were specific criteria assessed or was the assessment more subjective in nature? If the former, please describe the criteria. If the latter, please narratively describe the characteristics of "typical" operations.	Typical operations are "normal operations", those that encompass a range of flows that are accommodated by station discharge over the course of each day (which typically range from minimum flow up to medium-full station capacity with stable inflow) as occurs on most days outside of periods of high inflow. TransCanada developed an approach for selecting calibration flows that included a review of flow data (both in graphical and tabular form) to identify candidate 5-day flow periods for typical spill (>20,000 cfs) and for typical normal operations (up to station capacity – turbines are either on or off and the graphs of flow vs. time show turbine operation very clearly) flows. Criteria used in flow selection (a.k.a. time period selection) were based on the following: 1. We reviewed the window of 2014 Study 2 logger deployment, which spanned from June 25, 2014 to October 31, 2014. 2. Within that window we identified time periods that represented typical operations and spill events and verified these time periods with project operations data. 3. Within typical operations and spill event time periods, we reviewed the logger records for uninterrupted data spanning 5-7 days (e.g., time periods free of data interruptions such as loggers out of water, frozen loggers, vandalism, barometer changes, logger relocation, etc.). 4. We reviewed the time periods identified for the loggers with data for the USGS gages to check

Comment #	Study #	Source	Comment	Response
				data availability at the gages. 5. We presented the selected time periods and locations (Study 2 loggers and USGS gages) during the Study 4 Consultation Call, (July 20, 2015) with the water resources working group. The approach for selecting calibration flows and time periods for those flows was presented to agencies via conference call on 7/20/2015 to confirm the approach (see meeting notes and presentation in Appendix A of the Updated Study Report filed September 14, 2015). Questions were asked during the consultation call but no modifications to the approach were suggested at the meeting or subsequently. Thus, Study 4 calibration was implemented based on the approach discussed during the conference call.

Study 5 – Operations Modeling Study

Comment #	Study #	Source	Comment	Response
1	5	CRJC	The operational model (Study No. 5, Operations Model) [should] be optimized to manage ramping rates and frequencies in a manner that minimizes erosion and reduces mercury accumulation. Based on the science, CRJC requested that mercury in fish tissues and sediments be tested by TC to identify mercury levels in order to inform possible mitigation measures. We repeat that request here, as more recent	TC is prepared to evaluate alternative operating conditions using the Ops model and the development and specification of those scenarios needs to be coordinated based on all the various resource studies so there is broad representation and input. We are not prepared to examine endless iterations due to the amount of time, effort, and data analysis that would be required. By having a more comprehensive discussion about alternative

Comment #	Study #	Source	Comment	Response
			research indicates reservoir water level fluctuations do enhance methylmercury production, a process that can result in elevation of methylmercury concentrations in biota, even in older reservoirs (https://www.researchgate.net/publication/279634886)	operating scenarios to be examined, the approach and data analysis can be managed properly. We will initiate stakeholder discussion on this topic when the resource studies, particularly Study 9 - Instream Flow, are completed. With regard to mercury, we believe that the cited study is not applicable since that project involved seasonal impoundment drawdowns of 4 m, and was located next to an old mine. Atmospheric deposition has been shown to be the primary source of mercury accumulation in fish tissue in the Connecticut River, and USEPA studies on fish tissue contaminants indicated that mercury in sediments was not found at any locations in the NH/VT section of the CT River above lab reporting limits. (see p. 29 in https://nepis.epa.gov/Exe/ZyPDF.cgi/P10068YQ.PDF?Dockey=P10068YQ.PDF). That report also concludes that **"It is not believed that Connecticut River sediments are a significant source of mercury in fish".** [emphasis added]
2	5	CRJC	TC should incorporate into the hydraulic and operations models scenarios of more intense storm events and prolonged periods of drought that are based on recent historical data and predicted by the preponderance of climate models.	See response to Study 4, comment #1.
3	5	VANR	TransCanada had previously presented data supporting the selection of the five modeled hydrologic years and calibration data to the aquatics working group, but inclusion of that information in the report would help to provide context to the results. Please include prior	FERC modified the RSP (in their September 13, 2013 Study Plan Determination) as follows: "The study plan report [rather than the study plan] must demonstrate the appropriateness of TransCanada's 5-year representative hydrologic subset, show how

Comment #	Study #	Source	Comment	Response
			consultation describing calibration and support for selecting the five hydrologic years as an appendix.	the selected years are representative of the longer hydrologic record" . This information is provided in Section 4.1 of the study report, and in Figures 4.4-4.6 which demonstrate the close fit between flow duration curves for the five selected representative model years and the 30 historical years of available data.
4	5	VANR	Section 4.1 Model Development – The report states, "Update econode Habitat Suitability Index (HSI) rating curves (function of flow and/or elevation) defined in Study 9 – Instream Flow Study." Please clarify whether this statement refers to traditional rating curves (stage vs. flow) at the study 9 transects or curves that relate flow to habitat suitability (HSI vs. flow).	The statement refers to Study 9 habitat suitability curves, specifically Area Weighted Suitability (AWS) and Weighted Usable Area (WUA) curves as defined in Study 9 – Instream Flow Study. Study 5's contribution to Study 9 was in evaluating those relationships at Study 9 transects and 2D sites based on field data collected in Study 9 (see Study 9 interim report filed March 1, 2016).

Study 6 – Water Quality Monitoring and Continuous Temperature Monitoring Study

Comment #	Study #	Source	Comment	Response
1	6	CRJC	Study No. 5, Operations Model, and Study No. 6, Water Quality Monitoring do not address the accumulation of mercury in the river and their effects on fisheries and public health. We previously provided evidence that indicates fluctuating water levels in reservoirs exacerbate the accumulation of mercury in fish. (e.g., https://www.niehs.nih.gov/research/supported/assets/docs/a_c/bioscience_508.pdf).	See response to comment #1 in Study 5 above relative to the Study 5 comment here. With regard to Study 6, we addressed the original request to include sampling of sediments for mercury in our Revised Study Plan (Appendix E) filed September 13, 2013. Both NHDES and VANR approved the Study 6 Sampling and Analysis Plan which did not include sediment sampling, and FERC did not require such sampling in its February 21,

Comment #	Study #	Source	Comment	Response
				2014 Study Plan Determination. We also note that the cited report does not indicate any mercury "hotspots" within the project-affected area.
2	6	CRJC-UV	Sampling occurred only during the late spring, summer, and early fall months, thus missing the nutrient and solute loads present throughout the cold weather months, especially spring runoff.	We adopted comments from both state WQ agencies in the revised and approved Sampling and Analysis Plan filed September 14, 2015.
3	6	CRJC-UV	The sampling method described in Methods 4.1.4 (page 13) consists of lowering a flexible PVC tube to within 1 meter of the bottom, allowing it to fill with water from various depths within the water column, capping it, pulling it back up and emptying it into a bucket, from which sample bottles were filled. This technique appears to be open to cross contamination from multiple sources.	We adopted comments from both state WQ agencies in the revised and approved Sampling and Analysis Plan filed September 14, 2015.
4	6	CRJC-UV	There is concern that that the turbulence during high flow events such as spring runoff could cause elevated mercury (or other so-sequestered toxins') levels in the river water due to high levels of mercury in the river sediments. Yet mercury was not among the parameters selected for water quality monitoring, nor was spring runoff water sampled.	See response to comment # 3.
5	6	CRJC-UV	It is disconcerting to realize that the water quality sampling results for dissolved oxygen differed significantly from the first sampling period in 2012, and the sampling done in 2015, which the study report attributed to stratification during a high temperature – low-flow period (see 5.6, page 117-119). One could infer from this that there is so much variability in water quality that a much more diligent sample design should have been used.	The 2012 and 2015 studies reported on observed conditions. Tables 5.6-1 through 5.6-4 of ILP Study 6, filed August 1, 2016, show the DO levels measured over a similar sampling period between the two studies exhibited similar ranges, median, and mean levels. It would be expected that there would be some differences and variability between the two studies, such as the lower DO levels observed in 2012 that were attributed to brief stratification, because the data from the two

Comment #	Study #	Source	Comment	Response
				studies were collected under varying prevailing weather and flow conditions. 2012 can be considered a warm low flow year whereas 2015 can be considered a more typical flow year. This distinction is observed in Figure 5.6-1 in the report of ILP Study 6 that shows mean daily flows were more variable and of greater magnitude in 2015 than in 2012.
6	6	NHDES	Executive Summary: The Department disagrees with the following sentence on the second page: "However, exceedances were not associated with project operations; they were instead attributable to natural conditions (low flow, high air temperature) or potential nutrient loading from sources outside the projects." This suggests that the presence and operation of the dams have no impact at all on the exceedances, which is not supported by the data. The Department requests that this sentence be revised with language such as the following: "However, project operations were not believed to be the major cause of the exceedances; they were instead believed to be primarily due to natural conditions (low flow, high air temperature) or potential nutrient loading from sources outside the projects."	This statement will be changed in the revised report to address the recommendation.
7	6	NHDES	The Department also requests revisions to the last sentence of the Executive Summary, which currently reads: "Overall, the data from both the 2012 and 2015 studies show that, irrespective of the effects of project operations, water quality in project-affected waters supported the designated uses and met applicable Class B VT and NH surface water quality standards for the overwhelming majority of the study period throughout the entire study area." The Department requests that	This statement will be changed in the revised report to address the recommendation.

Comment #	Study #	Source	Comment	Response
			this sentence be revised to delete the word "overwhelmingly" as it is a subjective term, and to reflect that although water quality standards were met most of the time for the parameters which were tested, it does not necessarily mean that designated uses were met since designated uses can be impacted by many other parameters which were not sampled as part of this study. Language such as the following would be acceptable to the Department with regards to NH water quality standards (VTDEC may have other comments): "Overall, the data from both the 2012 and 2015 studies suggest that, irrespective of the effects of project operations, water quality for the parameters which were sampled in project-affected waters met applicable Class B VT and NH surface water quality standards for the majority of the study period throughout the entire study area."	
8	6	NHDES	The fourth sentence in the first paragraph on p. 112, reads as follows: " The continuous and vertical profile turbidity data collected at all mainstem monitoring stations indicate that turbidity would not exceed the NH surface water quality standard of 10 NTU beyond upstream waters under normal project operations." The Department requests that this be revised as follows since the data was not representative of all conditions: "The continuous and vertical profile turbidity data collected at all mainstem monitoring stations suggest that turbidity would most likely comply with the NH surface water quality standard of 10 NTU beyond upstream waters under normal project operations."	This statement will be changed in the revised report to address the recommendation.
9	6	NHDES	Section 5.5.1 New Hampshire Water Quality Standards, p. 112-113: The sixth sentence in the first paragraph	The statement was intended to acknowledge that the definition of "discharge" in Section 401 of the

Comment #	Study #	Source	Comment	Response
			reads as follows: " TransCanada does not 'discharge' a 'pollutant' as defined in Env-Wq 1702.18 and in 40 CFR §122.2, respectively." The Department disagrees with this sentence and requests that it be deleted since water discharged from dams can introduce pollutants per Env-Wq 1703.29 to the downstream receiving waters and is therefore considered a discharge per Env-Wq 1702.181. An example is heat associated with slower residence times in the impoundments which can result in higher temperatures being discharged downstream of the dam.	Clean Water Act (for purposes of water quality certification), differs from the definition in the New Hampshire water quality standards (relative to NPDES point source discharges). While the New Hampshire water quality standards apply to any activity that affects beneficial uses or the level of water quality, according to the Clean Water Act, the transfer of "polluted" water from one part of a water body to another part of the same water body is not a "discharge of pollutants". In that context, the passing of water from the impoundment through the powerhouse for hydroelectric generation is not a discharge of pollutants.
10	6	NHDES	Section 6.0 Assessment of Project Effects, p. 125-127: The next to the last sentence in the second paragraph on p. 126 references Figure L-6 in Appendix L for an example of when DO levels on July 18, 2012 fell below standards in the forebay but project discharges at Wilders and Bellows Falls remained well-oxygenated even with increasing and decreasing project discharges. Figure L-6 shows temperature instead of DO. This should be corrected.	The reference should be to Figure L-18 and this will be corrected in the revised report. We will also add the underlined text to the sentence so that it reads: "For instances in 2012 when DO levels fell below state surface water quality standards within <u>the hypolimnion of</u> the Wilder and Bellows Falls forebay, project discharges remained well-oxygenated even with increasing and decreasing project discharges (e.g., July 18, 2012; Figure <u>L-18</u> in Appendix L)."
11	6	NHDES	Section 6.0 Assessment of Project Effects, p. 125-127: The last sentence on p. 127 states the following: "Therefore, available data strongly suggests that currently, the three projects individually and collectively meet VT and NH state surface water quality standards and designated uses for Class B waters." The Department disagrees with this sentence because it contradicts previously statements in the same paragraph (and elsewhere in the study) which acknowledge that	This statement will be changed in the revised report to address the recommendation.

Comment #	Study #	Source	Comment	Response
			there were occasional exceedances of water quality standards in 2012 and 2015. The Department requests that this sentence be deleted and replaced with the Department's recommended last sentence in the Executive Summary (see comment above).	
12	6	VANR	A primary goal of the study is "to determine potential project effects on water quality parameters"... While the Agency appreciates the addition of monthly graphs with project discharge included in Appendix F… the Agency also notes that meaningful analysis and discussion of water quality parameters in the context of project operations (generation, impoundment elevation, discharge and associated water-level changes) is lacking from the report. The report continues to combine differing operational conditions by using daily or weekly mean values. Presentation and analysis in such a manner allows inferences to be drawn regarding water quality parameters over time, but not in regards to project effects…While the Agency acknowledges that water quality is influenced by many factors, analyzing the data on shorter timeframes (sub-daily) or in comparison to changes in project operation may help to exclude the influence of confounding factors. For parameters in which the standards are discrete instantaneous values (e.g dissolved oxygen), if there are not exceedances of the Standard, analysis in the context of project operations may not be necessary. However, for a parameter like temperature in which the standard is determined by the degree of departure from ambient temperature, analysis of the water quality parameter in the context of project operations is critical to determine project effects and compliance with water quality	There are a range of variables that can affect water quality in the impoundments to varying degrees including air temperature (including diurnal effects), mainstem flow, water level changes, tributary inflow, and latitudinal warming. The effect of these changes is integrated in the high-resolution measurements that were collected at 15-minute intervals at the monitoring stations. These and related data are provided in Appendices B to J, and Appendices L and M. The analyses in the study report based on those graphs (as well as on summary statistics; see further discussion below) have shown that some variables are more relevant than others. For example, water temperatures warm and fluctuate with air temperatures. Tributary inflows may affect the temperature in the mainstem, but since flows and temperatures are quite variable (e.g., see Appendices C and D) the degree of influence varies considerably and cannot easily be isolated in a 120-mile long combined study area. Low flows in the summer may result in occasional weak stratification (as observed at the end of August and the beginning of September). Higher flows (due to rainfall or snowmelt) result in higher turbidity due to particulate matter in runoff. Other factors that

Comment #	Study #	Source	Comment	Response
			standards… Consistent with the revised study plan, please analyze hourly generation, impoundment elevation, discharge and associated water-level changes on relevant water quality parameters" in order "to determine potential project effects on water quality parameters".	could affect water quality, such as water level changes, were assessed but found to have only a negligible impact on the water quality due to the comparatively small range in impoundment elevation changes (0.1 to 3.2 ft), and due to the typically unstratified water column (Appendix H). An unstratified mixed water column implies that water quality conditions remain similar independent of water level fluctuations. For the above reasons, for water quality parameters such as temperature and DO, the associated changes primarily reflected natural diurnal fluctuations particular at the middle, upper and riverine areas. The study report also provided summary statistics, such as the statistical mean over different time periods, to allow for analyses, inferences, or discussion with regards to project effects to be made, as they provide additional insight into the existing conditions. For example, the NH surface water quality standard for DO percent saturation requires the daily mean to be calculated, which is based on DO measurements continuously recorded over a range of daily project operations (which include peaking, minimum flow, perhaps spill, etc.). Therefore, if no daily mean DO percent saturation fell below the NH standard, as was observed in 2015, then the inference is that DO percent saturation in 2015 would comply with the NH water quality standard regardless of type and magnitude of project operations.

Comment #	Study #	Source	Comment	Response
				For assessing impacts for the next license term, the water temperatures and changes in water temperature from upstream to downstream will reflect existing conditions as TransCanada is not proposing a change in how the projects are operated. The frequency of temperatures increases more than 1°F would be closely related to air temperature as the data show the upstream river station used to assess compliance with the Vermont temperature standard is highly correlated with air temperature and weather changes. We revisited our analysis on the effects of water level and impoundment fluctuations and will add clarifying text to the revised report: In summary, we provided project discharge data, which reflects generation, in the appendices juxtaposed with water temperature, DO, pH, specific conductivity, and turbidity. We analyzed these graphics as well as calculated summary statistics to assess effects of project operations on attaining surface water quality standards, changes in parameters with associated discharges (i.e., within the tailrace), and to describe existing conditions. Because the water column was well-mixed with regards to the water quality parameters examined for the majority of the study period we determined the effect of impoundment water level changes to be negligible.
13	6	VANR	The Executive Summary states, "All applicable Vermont and New Hampshire surface water quality standards were met, with the exception of the upper limit for pH	See response to comment #12 and response to comment #6 (NHDES), which will include the following statement in the revised study report:

Comment #	Study #	Source	Comment	Response
			(VT and NH) and temperature (VT only). However, exceedances were not associated with project operations; they were instead attributable to natural conditions (low flow, high air temperature) or potential nutrient loading from sources outside the projects". The applicable temperature standard for cold water fish habitat in Vermont is "change or rate of change either upward or downward, shall not exceed 1°F (0.56°C) from ambient temperatures due to all discharges and activities and be controlled to ensure full support of aquatic biota, wildlife, and aquatic habitat uses". Without an analysis of how project operations (the activity) affect ambient temperature, compliance with the temperature standard cannot be determined and the potential effect of the project operation cannot be ascertained.	"However, project operations were not believed to be the major cause of the exceedances; they were instead believed to be primarily due to natural conditions (low flow, high air temperature) or potential nutrient loading from sources outside the projects."
14	6	VANR	5.1 Weather, Flow, and Operations – The Agency notes that project operations are not discussed in this section.	The purpose of Section 5.1 was to state and illustrate the weather, flow and project operation conditions the study was performed under. We note that project operations data are presented in Section 5.1 in Table 5.1-4 and Figures 5.1-1 through 5.1-6 (gage data and Project discharge data), throughout Section 5.5, and in Appendices F. We will add a paragraph in the report summarizing these data in this subsection.

Study 10 – Fish Assemblage Study

Comment #	Study #	Source	Comment	Response

Comment #	Study #	Source	Comment	Response
1	10	FWS	Figure 5.4-2 should be graphed so that all of the included data is clear. One option is to alter the y-axis so that it contains a break, allowing the reader to view high and low values for each species and discern between percent composition within impoundments, riverine reaches, and the Bellows Falls bypass reach.	This information is shown graphically in several formats in Figures 5.4-3 through 5.4-10, in detail in Appendix J, and is summarized in Tables 6.0-1 and 6.0-2. We were unable to adequately display the data as requested in the comment; however, we will provide the data shown in Figure 5.4-2 in Excel format in a forthcoming report supplement.

Study 13 – Tributary and Backwater Fish Access and Habitats Study

Comment #	Study #	Source	Comment	Response
1	13	FWS and VANR	For this study, depths greater than 0.5 feet were assumed to provide adequate access for fish to enter into tributaries and backwater areas from the mainstem Connecticut River and vice versa. However, recently published Federal guidelines of nature-like fishways require a minimum channel depth of 1.5 feet, 2.5 feet, and 1.75 feet for rainbow smelt, brook trout, and juvenile salmonids respectively (Turek et al. 2016). Thus, the defined criteria, considering all depths greater than 0.5 feet, is a very low threshold depth for access, especially when combined with the 50 percent-of-day criterion discussed below.	The 0.5 ft criterion was included in the initial study report filed September 14, 2015 and there were no comments on that report about that criterion. There was also no discussion at any study meetings about applying nature-like fishway guidelines to the access criterion of 0.5 ft. Applying those guidelines to an assessment of access is inappropriate because the guideline assumes construction of fishways over physical barriers where diadromous fish congregate. In Study 13 the only physical barriers observed at tributary study sites were unrelated to the projects or their operations (e.g., perched culverts, natural barriers, debris).
2	13	FWS and VANR	This section states [Section 6.1.2] that "this revised report includes the requested evaluation of study sites during the spring spawning period to identify periods of time with < 0.5 feet of water depth for one hour or more (the minimum model time step) as well as for 12 hours or more as originally proposed. The 12-hour	The comment is noted. Per previous comments we did revise the report to add the 100% criterion. However, we continue to believe that adequate access exists if such access is available for at least half of each day. The “100% of date” criterion data are included in Appendix C of the study report,

Comment #	Study #	Source	Comment	Response
			criterion ... is considered reasonable for quantifying adverse project effects as fish approaching from the mainstem would have adequate access under this criterion for no less than 50% of the total time...while the < 0.5 feet of access at any time is considered the most conservative condition." The Service does not agree that the 12-hour criterion is reasonable to quantify adverse project effects. For fish, especially for those making time-sensitive spawning migrations, limiting access to tributaries and backwaters up to 50 percent of the time can substantially impact spawning success as a result of delays and stranding.	which provides a side-by-side comparison of access categories at each study site for each criteria.
3	13	FWS and VANR	This section [Section 7] states that "while some study sites showed occasional or frequent project effects, these sites comprise a small fraction of all available fish habitat in tributaries and backwaters within the basin." However, the sample design was established to randomly select a subset of streams of various stream orders within project-affected areas. Therefore, sample streams were meant to represent the entire population of streams that could be affected by project operations.	We respectfully disagree and note that the statement on page 55 and Table 7.0-1 were intended to place study results into the larger context of the river as a whole within the study area. The study was designed to assess small streams, so while results can be considered representative of small streams with potential access issues (whether project-related or not), results cannot be considered representative of the total available and accessible habitat. A large portion of the available habitat is in larger tributaries that are barrier free. We also note that an error in Table 7.0-1 was discovered and a corrected table provided in the August USR meeting summary document filed August 31, 2016.
4	13	FWS	The study concludes that "normal project operations have little to no effect on fish ability to access	As stated in the report Executive Summary, “analysis based on summer/fall 2014 observations

Comment #	Study #	Source	Comment	Response
			tributaries." However, Table 6.1.2-3 indicates that over 40 percent of the sites frequently had water depth less than 0.5 feet. This is a substantial portion of sites with access issues, during a time when fish make spawning migrations into tributaries. Considering the biological importance of low-order streams, which provide valuable spawning and rearing habitat, these data indicate a significant impact when taking into account the total number of streams that likely have project-related access issues.	and water level logger data, and based on hydraulic and operations model (Studies 4 and 5) data for spring time (April 1 – June 30) indicate that normal project operations have little to no effect on fish ability to access tributaries on most days". We continue to believe that adequate access exists if a depth of 0.5 ft is available for at least half of each day. When those conditions are considered, approximately 10 percent of the sites frequently have water depths less than 0.5 ft. As evidenced during field visits to these locations, access issues at these tributaries were more likely related to factors such as low to intermittent tributary flow and tributary water depths, accumulation of debris from within or adjacent to the tributary, or culverts, more than to normal project operations.
5	13	NHFGD	The threshold of flows greater than 0.5 feet for at least 25% of the time may not capture accessibility during critical time periods for certain species. The period when the mainstem temperature begins to exceed 20 degrees Celsius, usually occurring in late June, is important for trout species seeking thermal refuge in the tributaries. Sea lamprey spawning season in the spring (mid May to late June) and trout spawning season (mid-September to late October) in the Fall are also important time periods. A closer look at tributary accessibility during these time periods across multiple modelled flow years may be warranted.	The direct observations in summer and fall of 2014, included extended periods of low flow and adequately assesses tributary accessibility during those periods and encompassed the period September - October. We continue to believe that the field study period assessed the most critical set of flow conditions to determine tributary access, regardless of water temperature. We used the model in the spring period as a secondary method in lieu of springtime field work and the spring period (April – June) encompasses the Sea Lamprey spawning period. That period would likely have higher flows than the 2014 summer/fall field assessment.

Study 14/15 – Resident Fish Spawning in Impoundments and Riverine Sections Study

Comment #	Study #	Source	Comment	Response
1	14/15	CRWC	It seems ironic that the report offers Figure 4.1-4 solely as an example of the vertical orientation of perch egg masses because it is a view of dewatered eggs. It is also a picture of what fishers in the Bellows Falls area see in the setbacks north of the Bellows Falls dam every year. That sight concerns them greatly.	The purpose of including that Figure 4.1-4 was to illustrate how yellow perch egg masses hang vertically, and from where top elevations were measured. While some egg masses were dewatered, some were not and we note that in-water egg masses also hang vertically. As described on page 24 of the report: "Elevations of Yellow Perch egg masses were measured on the substrate adjacent to the egg mass, unless the egg mass was suspended over branches (Figure 4.1-4). For suspended egg masses, elevations were measured at the highest elevation (e.g., at the suspending branch) and in some cases also at the lowest elevation (e.g., typically the substrate)…For each egg mass, only the upper elevation was used for comparison with measured WSEs; consequently any WSE that dropped below this maximum elevation was conservatively assumed to dewater the entire egg mass, even if a significant proportion of the egg mass remained within the water column at low water levels."
2	14/15	CRWC	CRWC agrees with the VT Fish &Wildlife Department that egg laying and maturity are a function of water temperature much more than of the day on the calendar. TransCanada needs to base operations on temperature -- not the day of the month during spring and fall spawning periods. Yellow perch is a favored game fish and the high loss of eggs should prescribe a change in operations during the spawn.	The comment is noted. We agree that spawning is a function of temperature as well as other factors.

Comment #	Study #	Source	Comment	Response
3	14/15	FWS	This section [Section 4.2.2] states that "dewatering and egg or nest failure was assumed to occur when the water surface elevation dropped below the elevation of an egg mass or active nest. Yellow perch eggs are encapsulated within a moist, gelatinous mass, and brief periods of exposure did not appear to affect viability." We strongly suggest that this statement on viability be removed, as the critical time period of dewatering that does not impact viability is not known for this species (as described in the New Hampshire Fish and Game Department's [NHFGD] April 29, 2016 comment letter).	Our re-analysis in the final report assumed that any amount of dewatering resulted in egg mortality, so the statement on viability does not have any effect on the results of the analysis. That statement and many others in the report serve to point out that our analysis repeatedly utilized conservative protocols that help to ensure that mortality estimates were not underestimated.
4	14/15	FWS	Water visibility [Section 5.1.3] was noted as having an effect on most spawning surveys (excluding egg-block sampling), due to the visual nature of identifying and observing adult spawners, egg masses, or constructed nests. The report states that "this factor necessarily biases the spawning assessment towards shallower habitats that are more vulnerable to dewatering, since deeper and less vulnerable eggs and nests were likely present, but largely undetected due to limitations in visibility. Consequently, estimates of project effects on egg or nest sites are conservative and likely to be over-estimated." The Service notes that these biases or over-estimations are assumed and are not supported by any data that demonstrates the existence or amount of spawning by various species in deeper areas.	The comment is noted. Review of the literature on spawning behavior (Appendix A of the final study report) for most of these species shows that observed ranges in spawning depths can exceed the 3-5 ft of visibility typical of the spawning surveys conducted in 2015. This serves as the basis for the language in the report.
5	14/15	FWS	[Section 3.2.3] Backwater surveys to collect northern pike and chain pickerel were conducted at 12 study sites from April 28 to July 2. Despite a high level of effort and observations of approximately 21 northern pike and 34 chain pickerel, none of the observed fish appeared to exhibit spawning behavior. Based on a	We agree that these species may have spawned earlier than observed in 2015, but flows earlier in spring are typically high and generally exceed project operations.

Comment #	Study #	Source	Comment	Response
			literature review, a wide range of spawning temperatures for this species were identified, which may or may not be applicable to the Connecticut River. The NHFGD previously provided details of northern pike spawning under the ice and large pike being caught at both Study Site 14-VB-039 and 14-VB-050 soon after ice out each spring. Therefore, it is the Service's position that spawning most likely occurred prior to the start of Study 14 and 15 surveys.	
6	14/15	FWS and VANR	Within this section [Section 5.2.4], it is estimated that "the percentage mortality of Yellow Perch egg masses observed in shallow margins of backwater habitats vulnerable to project effects ranged from 0% in the VB-050 backwater to 99.9% in the BB-019 (Black River) backwater (Figure 5.2-6), with an average overall mortality rate of 56%." The Service requests that the proportion of the total number of egg masses that were subject to any dewatering be included in the report as previously requested by the Vermont Department of Fish and Wildlife.	In response to comments on the interim report, each panel in Figure 5.2-6 in the final report shows the number of potentially dewatered eggs or nests versus the total number of eggs or nests observed at each study site, and the percentage of potential mortality at each site. The 56% overall mean value stated in Section 5.2.4 refers to the mean percentage of dewatered eggs or nests per study site, which is less than the total percentage regardless of study site and is not consistent with the metric used for the remaining species (total # dewatered/total # observed). For Yellow Perch, the proportion of total egg masses (conservatively based on any dewatering of an egg mass) across all study sites for those egg masses able to be assessed (a subset of all egg masses observed) should be 70.9% (581/819). We will provide clarification as well as clarifying notes in a revised Table 5.2-2, in a report supplement.
7	14/15	FWS	The report suggests [in Section 6.4] that it is possible that northern pike and chain pickerel responded to	We utilized numerous sources of literature to describe the potential ranges of spawning habitat,

Comment #	Study #	Source	Comment	Response
			periods of high, uncontrolled flow by spawning in inundated fields and riparian habitats that are normally dry during periods of controlled flow, citing McCarraher and Thomas (1972). We recommend that this language be removed, as these comments are speculative and there were no observations of this behavior during either study. Further, the McCarraher and Thomas (1972) paper discusses northern pike habitat selectivity preferences for specific aquatic floristic associations in the sandhill region of Nebraska and therefore this reference is likely not entirely applicable to the Connecticut River.	spawning behavior, and spawning periodicity over a wide range of locations and environmental conditions. Appendix A of the report includes information that pike and pickerel spawn in inundated marsh-type vegetation habitats that are often expanded during high flow conditions. Ultimate spawning success or failure in these habitats is unknown because there was no such behavior observed in 2015, and inundation during high flow periods are not a function of project operations.
8	14/15	FWS	Overall, Study 14 and 15 conclusions are echoed in TC's March 1, 2016 Updated Study Report - Response to Comments letter. Of concern are the references in both documents to walleye and white sucker being species that spawn upstream of project influences or in mainstem reaches deeper than sampled by egg blocks (>10-12 feet). Since white sucker spawn in rocky shallows or in moderate currents, while walleye have been observed spawning in shallow depths of rivers (Langdon et al. 2006), we do not agree with this conclusion. TC's letter states that …the lack of data pertaining to target species was a result of unobserved spawning, and spawning took place and was documented for species in the same "species group," which have similar habitat preferences and spawning periodicity. It is the Service's position that each target species has unique life history characteristics and spawning behavior, and therefore we do not agree that species in the same	We acknowledge that study data was not abundant for these species but the data consistently suggested that most spawners ascended tributaries above the influence of project operations or likely spawned in deeper mainstem waters. This conclusion was based on water level logger data, locations of eggs, and numbers of eggs collected in egg block sets (see Section 5.2.1 and Appendix B of the final study report). Sucker adults were also observed staging and walleye adults were also captured. For walleye, the conclusion is more speculative due to the lack of site-specific observations and a single egg collection even including surveys at sites selected by NHFGD as being likely walleye spawning sites. Our conclusion related to walleye is consistent with literature showing upstream movement of walleyes for spawning and the lack of egg captures in shallow mainstem locations, further supports our professional opinion and conclusion that spawning is likely to occur in those locations.

Comment #	Study #	Source	Comment	Response
			"species group" can be lumped together as suggested by TC.	We note that the concept of "species group" was included in the site selection report "SSR" (filed I Volume II of the September 14, 2015 Updated Study Report). The SSR had been previously provided in draft and final versions to the aquatics working group and discussed at the December 17, 2014 and February 10, 2015 consultation meetings (where no comments were received questioning the use of species groups). Species group was based on similarities in spawning preferences. We note that the report does not focus on species groups in analysis or conclusions and does not "lump" species groups together.
9	14/15	FWS	We believe that there is not enough data to assess potential project-related effects for 8 of the 13 study species ...Thus, we recommend that Studies 14 and 15 be repeated in 2017 for walleye, white sucker, largemouth bass, black crappie, northern pike, chain pickerel, spottail shiner, and golden shiner. Given that project operations have the potential to adversely affect spawning behavior of these species, either due to flow or impoundment level fluctuations, it is imperative that robust spawning data are gathered for use in the analysis of project impacts.	We respectfully disagree that there is not enough data to access potential project effects, and the final study report expands the analysis in the interim report to include modeling results that we believe achieves the study goals and objectives. Furthermore, FERC concurred in Appendix B of its June 29, 2016 Study Plan Determination on the interim report filed March 1, 2016 based on a similar comment made on the interim report. For riverine reaches, results from Study 9 – Instream Flow Study will help to identify additional potential project effects.
10	14/15	NHFGD	One potential impact not considered in this study is the influence of water level fluctuation on backwater spawning habitat quality. Fluctuating water levels may alter the aquatic vegetation community along the shallow margins of these backwaters. They may also affect fish behavior as the backwater changes in depth	We agree that fluctuating water levels in backwaters may affect fish spawning, and potential project effects of backwater fluctuations on spawning is included in the study report. With regard to aquatic vegetation, Study 27 – Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats Study,

Comment #	Study #	Source	Comment	Response
			and area over a relatively short period.	noted that the studied vegetative species are relatively intolerant to desiccation, and largely found below typical water levels. Project operations only marginally affect these communities and habitats such that suitable habitat is largely immersed in backwater areas particularly during spring high flow spawning periods.
11	14/15	NHFGD and VANR	[The report states on page 128] "Despite the high proportion of spawning days when WSEs exceeded spawning WSE criteria, Yellow Perch appear to remain at high abundance in all project reaches (e.g., first in abundance in the Wilder impoundment, Study 10 [Normandeau, 2016b]), and consequently the population of Yellow Perch does not appear to be adversely affected by either normal project operations or high flow operations." The justification that yellow perch and smallmouth bass are among the most abundant species found in the fish assemblage study, and therefor successful spawning must be occurring is not valid. These species were chosen in part because of their abundance to facilitate the evaluation of project effects on spawning behavior. The relative abundance of each fish species under existing conditions is irrelevant because it cannot be compared to the fish assemblage that might exist under a different management regime in which flows fluctuated more naturally (Yoder 2015).	As the comment notes, that statement in the report was specific to the apparent "robust" population of Yellow Perch as described on page 58 and based on observations and/or catch in this study as well as Study 10, and the large number of larvae collected in 10 of 12 backwater study sites. The report is also clear that some dewatering of Yellow Perch eggs occurred and thus there is apparently some project-related dewatering of egg masses. Study 10 did not report any significant age-class gaps for these species, so there seems to be a consistent, robust population in the study area, regardless of some egg/nest dewater that may or may not be related to project operations. We also note that the correct project effects assessment baseline is current Project operations not a comparison to populations under other potential management regimes or operating scenarios.
12	14/15	NHFGD	[The report states on page 128] "However, it is also likely that existing branch elevations are determined in part by the current range of normal WSE fluctuations, and changes that produce more consistent inundation	The comment is noted.

Comment #	Study #	Source	Comment	Response
			of branches may lead to decomposition of such branches and a return to a state of diurnal inundation of terrestrial vegetation." This statement fails to acknowledge that new branches and trees would continue to fall into the water.	
13	14/15	VANR	In earlier correspondence the Agency recommended that TransCanada develop a sampling plan that would involve sampling earlier in the season and target species where no or limited spawning data was collected…The request was not adopted as it was suggested that the information collected during studies 14 and 15, combined with existing literature and other project-specific information collected in others studies that describe habitat, water level fluctuations, and water surface elevations at likely spawning sites for these species, will be adequate to describe project effects and inform the development of license conditions. As such, we recommend that additional analysis consistent with the above recommendation… be included in the report.	The final study report expands the analysis in the interim report to include modeling results that we believe achieves the study goals and objectives. Furthermore, FERC concurred in Appendix B of its June 29, 2016 Study Plan Determination on the interim report filed March 1, 2016 based on a similar comment made on the interim report. For riverine reaches, results from Study 9 – Instream Flow Study will help to identify additional potential project effects.
14	14/15	VANR	Section 4.2.3 (Page 32) - The report states "Repeated backwater surveys indicated that Yellow Perch fry had hatched and egg masses were no longer present in the Bellows Falls backwater habitats by May 12, and Wilder backwaters appeared devoid of egg masses by May 14. Consequently, the estimated duration of incubating perch egg masses was truncated on May 15 for all study sites".	As noted in comment #8 above, species do show similarities within species groups but each species does have unique characteristics, and thus cannot be fully evaluated using identical methods. We attempted to remain consistent to the degree that was logical for each species and in response to comments received on the interim study report which requested consistent methodology across species. But, if available site-specific information

Comment #	Study #	Source	Comment	Response
			This approach is not consistent with the methodology of utilizing temperatures to determine when fry would hatch, nor was this approach included in the previous version of the report (March 1, 2016 filing). While it may be possible that fry hatched earlier than predicted at some locations, it is also just as likely that fry hatched later than predicted due [to] variability when analyzing regression relationships (R2=0.79 for yellow perch, and R2=0.86 for fallfish). Moreover, these are samples aimed to represent a population of egg masses, unless analysis occurs as to determine the probability of fry hatching earlier or later than the predicted relationships, results will inevitably underestimate project-related dewatering events. Therefore, we recommend that the original temperature-egg incubation relationship be used to estimate the length of time an observed Yellow Perch egg mass persisted at a particular location.	suggested a slightly different approach, such as truncating egg incubation after all perch egg masses had disappeared, we felt it was a reasonable and logical decision that would produce better estimates. In looking at the 11 plots in Figure 5.2-6 showing Yellow Perch egg incubation vs WSEs at each site, only one individual egg mass (of 819 total egg masses) would potentially result in a different conclusion if the truncation process was not adopted (the uppermost non-dewatered egg mass in WB-060). In all other cases the truncated periodicities would have resulted in the same conclusions (dewatered or not dewatered) if not truncated.
15	14/15	VANR	Section 4.2.3 - Based on descriptions on page 33, it is not clear if the data was analyzed according to the literature or site observations. Please clarify. For example, nests containing fry were assumed to remain active for an additional 20 days following the first observation of fry. However, Table 4.2-1 indicates that fry presence was observed up to 26 days. If site observations were made to make these assumptions, then we recommend that the maximum number of days be the assumption, especially considering the low sample size of some life- stages.	We acknowledge this inconsistency. We reviewed the smallmouth bass nest elevation vs WSE plots and found that extending fry residence from 20 days to 26 days would not result in any changes in the assessment of potential dewatering or nest abandonment.
16	14/15	VANR	Section 5.3.6 (Page 74) [states] “Because Fallfish lay their eggs at the level of the streambed prior to covering them with the mound of rocks (Reed, 1971;	As stated in the report, the 0.5 ft buffer inundates, on average, 90% of all Fallfish mounds, and contrary to the suggestion in the comment, the literature we

Comment #	Study #	Source	Comment	Response
			Magee, 1989; Maurakis & Woolcott, 1992), Fallfish nest elevations were measured at the base of the nest mound, and any WSEs that maintained at least 0.5 ft of depth at the base of the mound was considered to be fully protective of the eggs and larvae". In prior comments, the Agency recommended that the WSE be compared to the top of the nest mound rather than the base, as the literature suggests that the nest must be inundated to provide adequate aeration for developing larvae. The report should acknowledge that the 0.5 foot criteria is not based on reported literature. Considering fallfish nests are fully inundated at the time of construction, this analytical approach likely underestimates project-related effects.	reviewed on Fallfish fry distributions suggested they move towards the upstream edge of the mound (Maurakis and Woolcott, 1992); whereas no references we found suggested they migrate to the tops of mounds.

Study 16 – Sea Lamprey Spawning Assessment

Comment #	Study #	Source	Comment	Response
1	16	FWS	In this section [Section 4.4], TC identifies where data from other studies were used to complete Study 16. With respect to water level logger data, site-specific loggers were deployed only where nest capping was done. For other active nest sites, water level logger data from Studies 14-15 were used, even though the loggers were located varying distances from the actual survey sites. The report notes this, yet does not explain how (or if) using off-site loggers affected data analysis/model output. Analysis of this issue should be conducted and results should be provided in an	As stated in Section 4.5 of the report: The potential for nest exposure was evaluated using water level logger data specific to 2015 field conditions, and using Operations Model output for five discrete hydrologies. Note, however, that these are two separate analyses. The 2015 water level logger data collected in Studies 14-15 did not influence Operations Model output. Section 5.2.1 of the report compares results of both logger data and model output for each study site. Table 5.2.3 includes the location of level loggers relative to sampling sites

Comment #	Study #	Source	Comment	Response
			updated report.	and summarizes results of both analyses.
2	16	FWS	Dewatering analysis [Section 4.5] was done for each site, except those deemed to have insufficient habitat. The term "insufficient" should be defined. Further, in Section 5.2.1, descriptions of those same sites use the term "unsuitable." TC should use consistent terminology when describing the site characteristics.	The terms 'insufficient habitat' and 'unsuitable habitat' were used somewhat interchangeably and represented a range of conditions that were deemed inappropriate for Sea Lamprey spawning, including fine substrate dominance, excessive embeddedness of coarse substrates, and lack of swift flows; or that some characteristics of suitable habitat were observed, but others were lacking, within the project-influenced area. Descriptions of each site and site characterization are included in Section 5.2.1 of the report. These sites were therefore excluded from project effects analysis.
3	16	FWS	Sites WL-004, BT-006 and VT-014 had no documented nesting activity but were deemed by TC to have suitable habitat. Analyses of observed and modeled water surface elevations were completed for these sites, with the results reported in Appendices C, E and F. Given that project effect analyses were completed for these sites, it is unclear why the results were not reported in Table 5.2-3.	Analysis of potential nest exposure contained in the body of the report, specifically, Section 5.2, Table 5.2-3, included only those sites where spawning was confirmed, because analysis of project effects on all potential habitat was out of the scope of the approved study plan. Those results for sites with suitable habitat but without evidence of spawning were included in Appendices C, E, and F as additional data. We note that Study 9 – Instream Flow Study (Normandeau, 2016a) may provide additional information regarding project effects on habitat availability for Sea Lamprey on a broader scale.
4	16	FWS	While we understand that the analyses [in Section 5.2] were based on elevations of observed nests for those sites where active spawning was identified, at sites WL-004 and BT-006 (as depicted in Figure C-3 of Appendix C), the high and low elevations of suitable habitat were	See response to comment #3. The use of measured elevations of suitable habitat as surrogates for nest elevations for sites where spawning was not confirmed was considered, but rejected because those elevations may be subjective based on

Comment #	Study #	Source	Comment	Response
			collected and could be used as a surrogate for nest elevations. Figure C-3 shows that a portion of suitable habitat was dewatered periodically in 2015. Comparing 2015 data to the five model years (Appendix F), it can be seen that the change in water surface elevations was much greater in all five model years relative to those documented in 2015. This indicates that, on average, more of the suitable habitat would be exposed at higher frequencies and duration than indicated by the 2015 data presented in Figure C-3. It is also unclear why the high and low elevations of suitable habitat were not presented on Figure C-16 (site VT-014).	accessibility under the conditions observed at the time of measurement. Additionally, since spawning was not identified at those locations and elevations, any comparison to potential exposure of known spawning sites and elevations would also be subjective.
5	16	FWS	In previous sections of the report, sites WL-003, BT-031, VT-040 and VT-046 all are described as having "insufficient" or "unsuitable" habitat, yet the narrative descriptions of these sites appear to confirm that suitable substrate was present (although for some sites, like Site WL-003, it is unclear if the suitable habitat was within the project-affected area or not). In addition to the narrative descriptions, Table 5.2-2 shows that the four "insufficient habitat" sites had suitable substrate and/or embeddedness (i.e., they had similar substrate and embeddedness as sites with active nests). TC should explain the basis of its determination of "insufficient" or "unsuitable" habitat at these sites. These four sites were excluded from project effects analyses. Given that the narrative descriptions of these sites in Section 5.2.1 suggest there was suitable habitat	See response to comment #2. With regard to sites WL-004, BT-006, and VT-014, these sites included suitable substrate, depth, and velocities indicative of suitable habitat. Therefore, they were included in the general project effects analysis (WSE fluctuation range and rate of change), but nest exposure was not evaluated since no nests were found at these sites.

Comment #	Study #	Source	Comment	Response
			at all four sites, the Service requests that TC include them in the project effects analyses (similar to what was done for sites WL-004, BT-006 and VT-014, as presented in Appendices C, E and F) or provide an explanation as to why they should be excluded.	
6	16	FWS	TC lists several potential mitigating factors [in Section 6.1] to consider when evaluating the risk of nest exposure. Below we provide responses to some of those factors. I. One factor listed is that nests may not constitute the sole rearing habitat. TC goes on to cite Smith and Marsden (2009) in support of this rationale, stating "Only a small portion of eggs are deposited in nests or remain there once deposited. This may reflect a bet-hedging spawning strategy that Sea Lamprey have evolved..." We have reviewed the referenced paper and can find no mention of this bet-hedging hypothesis…[comment continues with additional detail]. Based on the conclusions of Smith and Marsden (2009), the Service's position is that conditions in the nest are best suited for successful egg hatching, and survival and conditions that promote egg retention in the nest (including flows within the operational control of the projects) should be examined.	The bet-hedging reference was incorrectly listed in the study report, and should refer to: Smith and Marsden, 2006 upon which the referenced citation, Smith and Marsden, 2009 was based. The correct citation is: Smith S, Marsden JE. 2006, Distribution and Factors Affecting Survival of Sea Lamprey Eggs In and Out of Nests Lake Champlain Basin Program. Technical Report No.49]. We agree that nest conditions are typically the best suited for egg hatching. The reference was intended to point out that dispersion of eggs outside of the nest occurs. That suggests that, substrate and predation issues aside, nest dewatering does not necessarily result in total loss of the cohort.

Comment #	Study #	Source	Comment	Response
7	16	FWS	Another mitigative factor identified by TC is that not all lamprey nests may have been occupied (i.e., were not "active" nests with eggs and/or larvae in them) and an unoccupied nest that becomes exposed does not constitute a detrimental effect. This argument may or may not be true. It could be that the nest is unoccupied because of abandonment in response to fluctuating water levels due to project operations. Nest abandonment could constitute or equate to a detrimental effect, because even though there is no direct impact on incubating eggs, abandonment could represent lost production potential if spawning lampreys had to construct another nest in sub-optimal habitat.	The intent of this mitigating factor was to point out that, because the analyses included a two-month period, in some cases incidence of nest exposure occurring during that extended period might not be coincident with occupancy.
8	16	FWS	A third mitigative factor identified by TC is that arnmocoetes have been shown to survive some dewatering (Liedtke et al. 2015). We believe stakeholders have previously pointed out that the subject study was directed at nests containing eggs, not burrowed ammocoetes. TC has provided no data relative to the survival rates of dewatered eggs.	This mitigating factor was intended, as in response to comment #7, to point out that the two-month period analyzed is substantially longer than the egg gestation period.
9	16	FWS	As in section 6.2, this section [Section 6.3] contains TC's description of potential mitigating factors to project effects based on degradation, scour and deposition. One of the factors identified is that deposition of sediments likely is not detrimental and may be protective. Again TC uses Smith and Marsden (2009) to support this contention, stating that the authors "found that Sea Lamprey eggs incubated in fine silt survived at a higher rate than those incubated without substrate" and "that suffocation by silt may not be a major factor influencing mortality of lamprey eggs." In fact, while	This mitigating factor was intended to provide balance to the results presented in Table 6.3-1. We agree that the distinction between eggs incubated in silt and deposition of fine sediments in the nest should be made, and recognize that Smith and Marsden (2009) did not address the deposition factor. But we referenced their study results to support our hypothesis that fine sediment deposition in nests, as observed in Study 16, should not necessarily be construed as detrimental to egg viability.

Comment #	Study #	Source	Comment	Response
			results of Smith and Marsden's (2009) laboratory experiments did show higher egg survival on silt and sand versus gravel, the field trials revealed that no eggs survived to hatch on silt. Further, the authors conclude that "Our field studies indicate that eggs deposited on silt substrate are more vulnerable to predation, drift, or both than are eggs deposited on gravel." Clearly there appears to be a distinction that should be made between eggs incubated in silt (which field trials indicate does not result in hatch success) and silt and sand that may settle over a lamprey nest during the course of the spawning season, a factor not addressed in Smith and Marsden (2009).	
10	16	FWS	[Section 6.4] Results indicate project operations impact sea lamprey spawning through fluctuating water surface elevations which periodically dewater lamprey nests. What we do not know is the overall proportion of available habitat affected by project operations. The 2015 data indicate that up to 81 percent of identified nest sites were dewatered at some point during the spawning season. As TC notes in the report, the model analysis does not reflect specific conditions observed in 2015 (which was an unusually wet June, leading to higher-than-average water surface elevations); thus, using the model is problematic in terms of assessing actual project effects. The Service does not disagree. It is possible that in a more typical water year, lamprey nest sites would have been located in different areas (including different tributaries), which could then make them either more or less susceptible to project-induced effects such as dewatering. Unless the study is repeated over multiple years under varying hydrologic	We agree that 2015 represented a snapshot in time, in keeping with the study's one-year effort in the approved study plan. We also note that during periods of high flow, TC's "high flow" operations that pre-draw impoundments to accommodate high inflows in combination with the high inflows themselves result in larger fluctuations in water surface elevations during those period, relative to normal project operations and routine water level fluctuations. The modeling analysis accounts for the predicted range of exposures over a range of representative hydrologies including both dry and wet years.

Comment #	Study #	Source	Comment	Response
			conditions, there is no way to know for sure, and we must rely upon the data presented in the report.	
11	16	NHFGD	[The report stated on page 87] "Although the proportion of the spawning population using continuously inundated habitats is unknown, it is erroneous to assume that all spawning occurs in shallow water." The relative viability of deep water nests compared to shallow water is unknown. It appears that 2015 was a relatively high flow year and greater nest exposure would have occurred in previous modelled years, assuming that nests were established at similar elevations. It is likely that some level of nest exposure occurs in most years. The influence of water level fluctuation on spawning behavior, nest construction, and egg survival was not evaluated. Over 52 miles of potential spawning habitat has been inundated by impoundments. This increases the importance of the remaining riverine sections. While spawning has been documented in the tributaries of the Connecticut River, the extent of spawning habitat necessary to maintain a healthy sea lamprey population in the Connecticut River is unknown. The relative importance of tributary vs. mainstem river spawning was not evaluated. Access to spawning tributaries may vary each year. None of the tributaries used by sea lampreys for spawning were evaluated for accessibility in Study 13.	The habitats surveyed were done so in accordance with the approved study plan and generally disregarded deeper habitats. Observations suggested spawning may routinely occur in deeper water habitats that are continuously inundated under all operational scenarios. See response to comment #11. We agree that every year is different which may result in variable conditions to which Sea Lamprey are exposed; however we disagree that nests would necessarily be established at similar elevations in different years. The study analysis did show that some level of nest exposure at some sites occurs in some years based on modeling and on 2015 observations. Evaluation of the relative importance of tributary vs. mainstem spawning was beyond the scope of the approved study plan. We also note that Study 13 focused specifically on small tributaries of stream order 1-3. Based on this study's telemetry, use of those tributaries by Sea Lamprey was likely limited.
12	16	NHFGD	[The report states on page 86] "Vulnerable nest elevations were therefore most accessible to spawning lamprey in flow periods beyond project operations.	Nest construction is, at least at some sites and elevations at those sites, a product of the flow characteristics of a given season. The report includes

Comment #	Study #	Source	Comment	Response
			Spawning and gestation could occur entirely or mostly during extended periods of continuous submergence." High flow events rarely last the entire spawning season. In most years, spawning sea lamprey will experience some project influenced flows. It is interesting to note that the Black River, which had the greatest amount of active spawning activity among the tributary spawning sites, experienced the same period of high flows in June, but it did not result in any exposed nest sites.	analysis of modeled data representing a range of hydrologies including for drier years. While technically occurring within the project-influenced area, because of its distance upstream in the tributary, project effects were unlikely for the Black River spawning area observed.
13	16	VANR	The report describes severity of project effects by breaking project impacts into three categories 'no project effects, moderate project effects and project effects. Moderate project effects are defined as such because at least one nest elevation was continuously inundated. We disagree with this categorization as it underestimates project effects. As such we request that "moderate", and "project effects" be combined or tabulated separately in total to accurately reflect that 81% (13/16) of the sites were affected by the project.	In Section 6.1 of the report, it was stated that three sites (19%) had 'no project effects'. By extension, 81% of the sites had project effects, regardless of classification as "moderate" or "project effects". We included the intermediate "moderate" classification to distinguish sites where some of the spawning habitat as verified by identified nest, was continuously inundated throughout the season. The comment implies a criterion of any exposure at any time necessarily results in a project effect. We disagree, and find that evidence of continuously inundated nests at a site (that also had intermittently exposed nest elevations) likely represents a lesser level of project effect than a site where all nests were exposed at some point during the season. See also responses to comments #7 and #8.
14	16	VANR	Executive Summary (Page ES-2) – The report states, "only the most vulnerable habitats were surveyed, but it is likely that Sea Lamprey also spawned in relatively deep water, despite literature suggesting that spawning occurs at shallow depths".	The statement was based on observations in 2015, as evidenced by radio telemetry locations of fish in water more than 8 feet deep during the spawning season, which, when resurveyed during low water periods were approximately 2 feet deep or less when nests were identified. Comparison of nest

Comment #	Study #	Source	Comment	Response
			Given [that] this statement is not supported by the literature, based on the observations obtained from this study, please provide the proportion of deep (>5 feet) lamprey spawning sites that were observed. If this statement can't be supported by the literature or observations from the study, the Agency requests that the statement be removed.	elevations to the range of water surface elevations under normal project operations suggests that 45% of nests identified in 2015 could be >5 ft deep under operational control scenarios and potentially deeper in spill conditions (see Appendix E, 'Table of Nests by Site'). A review of the figures presented in Appendix C suggests that many nest elevations are frequently at depths > 5 ft for extended periods.
15	16	VANR	Section 4.5 (Page 22) - Water level loggers were only deployed where nest capping occurred (3 sites). For the remainder of the sites, logger data from studies 14 and 15 were used as a substitute. As stated in earlier correspondence we feel that utilizing data from pressure transducers that are miles away may not be represented of site conditions. As such, we request that in such cases analysis occur utilizing 2015 modeled data. This type of analysis may provide more accurate results.	The study report includes discussion of the use of water level loggers in 2015, to provide preliminary assessment of potential project effects (since model data was not available at the time of the interim report filing). The final report placed the use of water level logger data into context with the modeled data, and no site's project effects assessment relied solely on water level logger data. We continue to believe that the modeling analyses provide sufficient characterization of water levels over a range of representative hydrologies to assess the level of potential project effects.
16	16	VANR	Table 5.2-3 (Page 55) - Please include minimum and maximum durations (hours) to better understand nest exposure times and biological impacts from such events.	These values are included in Appendices E and F of the study report, for each site and each nest elevation.
17	16	VANR	Table 6.1 (Page 86) The report states, "Mortality was less than 7 percent for exposure periods of less than 24 hours (based on lab study). For nests in this study that experienced exposure, the average period of exposure at each site was no more than 11 hours based on 2015 level logger data and, except for one specific nest elevation at Site 16- BT-003, less than 24 hours for all model years".	Maximum durations of exposure as measured in 2015 (given limitations of level logger locations discussed in the report) and modeled for five hydrologies were included in Appendices E and F of the final study report. Those data indicate that 4% of nests experienced maximum exposure periods >24 hr during 2015. In the representative 'dry year' modeled, 1992, 32% of nest elevations experienced

Comment #	Study #	Source	Comment	Response
			Presenting average exposure time does not adequately describe the biological impacts from such events. Analysis should include the proportion of nests that were exposed for a time period greater than 24 hours. It should also be noted that laboratory experiments are conducted in controlled environments and are not always comparable to field studies. For example, and as stated in the report, "exposure of a nest that is occupied may result in a detrimental effect, such as prevention of access by adults during active nest construction and spawning, abandonment of nest construction or spawning, egg mortality due to desiccation or unsuitable water quality (such as when water in an exposed nest warms quickly), and mortality of ammocoetes". We recommend that increased risk of predation be included as potential impact. These additional impacts cannot be accounted for in a laboratory setting.	maximum exposure periods of >24 h. In the representative wet year, 1990, 0% of nests experienced exposure of >24 h. The report included examples rather than an exhaustive list of possible detrimental effects from nest exposure. We agree that increased predation may also occur.

Study 21 – American Shad Telemetry Study - Vernon

Comment #	Study #	Source	Comment	Response
1	21	CRWC	CRWC supports the recommendations from the US Fish and Wildlife Service and the VT Fish & Wildlife Department that TransCanada needs to do further work relative to measuring the actual success rate of the passage of fish at the project fish ladders. The report also needs to resolve how the information is present[ed] so there is less confusion about what it	The revised study report will resolve these issues as discussed in our responses below.

Comment #	Study #	Source	Comment	Response
			means that a shad or any other fish passed the dam using the ladder. We have numerous concerns regarding the American Shad Telemetry Study Report, including: (1) agreed upon details of the study goals and objectives were not addressed; (2) there is a lack of clarity of reported methods and data; (3) there is limited data presentation; and (4) there is very limited results description, data analyses, or discussion as specified in the Revised Study Plan and approved by FERC.	
2	21	FWS	An overarching concern for the Service is the representativeness of environmental conditions during the study, their effects on obtained data, and the ability to subsequently address Study Plan goals and objectives. River discharge has implications on several identified goals and objectives, especially as observed in the month of June and early July in 2015… We believe the frequency, timing, duration, and magnitude of these spill events require specific analysis relative to the impact of these events on results and conclusions. The non-representative flow conditions may also result in insufficient information upon which to draw conclusions and a second year of study may be needed.	We acknowledge that flows in June and early July were higher than average but there were also periods of time when we monitored fish movement under lower flow conditions that are representative of typical project operations. Flow conditions vary season to season but there is nothing in the report that suggests abnormal results that could be tied to environmental conditions that might lead to invalid analysis. We believe there were no data gaps or other conditions under the FERC study criteria that would warrant additional field study.
3	21	FWS	At the August 25, 2016 meeting, the term "foray" that was used in the report was defined as an event that starts when a shad enters the near-field area of the fishway entrance, and ends when it leaves that area, irrespective of the number of times the fish enters or leaves the fishway entrance… Each entrance attempt needs to be evaluated individually to assess whether different operational conditions affect entry. Multiple	We concur that that the definition of “foray” was not well stated or well applied in the initial study report. The revised report will provide a clear definition of what constitutes a foray and will provide re-calculated fishway performance metrics.

Comment #	Study #	Source	Comment	Response
			entries indicate a problem within the fishway that should be identified and corrected.	
4	21	FWS	The Service's May 2, 2016 letter to FERC on the March-issued study report included a request, detailing the need, rationale, and benefits of using the "time-to-event analyses" approach described in Castro-Santos and Perry (2012) to best understand project effects…	We note that the time-to-event analysis was requested after the study had been completed, and as discussed at the August 25, 2016 study meeting, the receiver system and design was not set up to accommodate such an analysis (see meeting summary filed August 31, 2016). Prior FWS comments submitted July 15, 2013 on the Proposed Study Plan indicated concurrence with the receiver design, stating: "Radio receiver and PIT reader coverage appears well designed to meet study objectives and is shown in figures and described in detail." And, in another comment in that submittal: "The outlined analyses appear appropriate." See comment/response table in Appendix E of the Revised Study Plan filed August 14, 2013. However, in an effort to address the concern about insufficient signal detection detail and correlation to project operations, we provided a bulleted list of additional analysis and data presentation to be included in the revised study report in Attachment 1 of the meeting summary. We received no comments on that list and have conducted the additional analysis specified in that list. It will be included in the study report revision.
5	21	FWS	The fishway attraction water system (AWS) is shut off at night, yet tagged fish were noted as entering the fishway when the AWS was off. This finding reinforces	While we concur that shad may not cease upriver movement at night, the majority of upstream fishway forays were initiated during periods when

Comment #	Study #	Source	Comment	Response
			the conclusion from another Connecticut River shad study that shad do not cease upriver movement at night (Dr. Ted Castro-Santos, U.S.G.S., personal communication).	the fishway attraction water system was on (corresponding to daytime hours). As noted by FWS, there were instances of tagged fish initiating forays into the Vernon fishway when the attraction water system was off. However, a base flow of 65 cfs is present through the fishway at all times during the passage season.
6	21	FWS	It is possible that, given the extensive period of high spill, the measures of residency time of fish in the tailrace moving upstream may have been reduced by some measurable quantity or in relation to changing operations, or conversely may have been more prolonged under lower flow operations. This factor should be analyzed and would be best evaluated by the rate-based approach.	See response to Comment # 4. Additional information on upstream residency time will be included in the revised study report as described in Attachment 1 of the August 31 filing.
7	21	FWS	We also have concerns with the data and conclusions provided by TC and presented in the report and its appendices. For example, TC identified 70 radio-tagged and PIT-tagged (dual-tagged) fish in the study area. Of these, eight shad appear from the telemetry data to have only reached Stebbins Island, four were detected by FirstLight (FL) telemetry to be in their study area at the same time as TC noted detections and one fish (#27-47) had conflicting detections between the TC and FL databases. Additionally, two dual-tagged fish (# 27-164 and 8-172) were detected in the fishway with PIT antennas but not by any radio receivers. Lastly, the report is not clear on the type of radio-tag receiver used at each receiver location, which has implications for the use of the "continuous record time out" (CRTO) option that Lotek receivers allow. The	The revised report will be updated to incorporate temporal and spatial distribution of fish detections based on the full data sets of manual and stationary telemetry data collected by both TransCanada and FirstLight. The FirstLight information was not available at the time the initial report draft was prepared. Each of the potential discrepancies noted in the comment will be reviewed and clarifications made as needed. Although not specified in the study plan, the use of the CRTO feature was employed at stationary monitoring locations where Lotek radio receivers were installed. The revised report will include specifics as to what type of monitoring equipment was installed at each stationary receiver location and what the data logging settings were. In addition,

Comment #	Study #	Source	Comment	Response
			Orion receivers maintain a full period of record. The Study Plan did not identify the use of the CRTO feature, which has potential implications to data analysis. Receiver locations, types and settings need to be explicitly identified in the report.	potential implications from the use of CRTO will be discussed.
8	21	FWS	At the August 25, 2016 TC report review meeting, the Service noted the omission of any survival data or discussion in the report regarding upstream or downstream passage mortality, as required in the Study Plan.	We refer the commenter to Attachment 1 in the meeting summary notes filed August 31, 2016. These data will be included in the revised study report, based on available information (e.g., available FirstLight data) and subject to limitations of determining survival within the context of the approved study plan.
9	21	FWS	As noted in our comments on the upstream passage evaluation, the proportional passage approach used for the downstream analyses, binned by intervals like river discharge at the instant of passage, does not fully describe project operational effects. The rate-based [e.g, time-to-event] approach should be used… Given limited data, it is important to understand the variable conditions each tagged fish experienced when it reached the dam and how these conditions subsequently influenced its: (1) route selection(s); (2) delay before passing; and (3) survival…	See response to Comment # 4. This information will be included in the revised study report, as described in Attachment 1 of the August 31 filing (see also response to comment #4 above).
10	21	FWS	[W]e have examined the telemetry data records TC provided and have drawn different conclusions on the route selection and fate of a number of test fish based on receiver detection locations, signal power and duration of tag signals (data assessment by Don Pugh)… We provide the rationales for our assigned route of passage, or failure to pass and fate/mortality in Tables [1, 2 and 3 in the FWS comment letter, along with additional discussion on this topic].	TransCanada has received tracking information recorded by FirstLight and has reviewed that data in time sequence with the existing TransCanada data set. We will assess his results, rationale, and discussion against our re-analyzed and reprocessed data and present our conclusions in the revised report.

Comment #	Study #	Source	Comment	Response
11	21	FWS	The above-noted frequency of spill in 2015 has significant effects on Study 21 results. The most obvious is that the high frequency of spill in 2015 may confound the determination of passage results and does not represent typical June and July operational conditions when post-spawn fish are most likely to move downstream. In fact, 60 percent of study fish passed under spill conditions. The higher frequency of spill may also reduce the residency time of outmigrant shad that encounter the project. However, the report does not examine or report data, analyses, or results on the study objective of residency or delay.	See response to comment # 2. For the proportion of fish that did not pass during spill, the revised study report will include data on passage routes and residency and compare those data to fish that passed during spill.
12	21	FWS	Table 5.6-2 summarizes egg and larvae collection data by habitat type. For the riverine sites, data are only broken down by mesohabitat type, not by substrate...it still should be possible to identify what the substrate was at a given riverine site, as that information was necessary to conduct the instream flow study. We recommend revising the table accordingly. It also would be helpful to have the data broken down between Bellows Falls riverine and Vernon riverine (rather than lumping both riverine segments together.	The revised report will include additional details on substrate in riverine reaches and will distinguish between collections in the Bellows Falls and Vernon riverine sections.
13	21	FWS	During each ichthyoplankton collection event, water quality and velocity data were collected, but not depth. Given that depth is one of the key physical habitat parameters that changes based on project operations, it should have been measured. TC should explain why depth was not measured. We do note that in Section 6.3, TC states that shad were "generally found in...depths between 1.0 and 2.9 meters..." However, the associated spreadsheets (Appendices C and D) only contain depth data for where the ichthyoplankton net	Water depth was measured but inadvertently excluded in the appendix data. The revised report will include this information.

Comment #	Study #	Source	Comment	Response
			was set.	
14	21	FWS	Ichthyoplankton sampling was conducted downstream from where shad were tracked. Using this method, TC may have missed "active" spawning sites with no tagged shad. Since very little splashing was noted at the sampling sites, indicating ongoing spawning, it is not clear whether or not spawning was occurring at the sample sites. Since eggs drift downstream, eggs collected may have been collected from ongoing spawning at that site, but could have drifted from undetermined spawning locations upstream. Given that actual spawning cannot be confirmed at the sample sites, it is difficult to draw conclusions based on the egg collections.	Ichthyoplankton sampling was conducted in the vicinity of locations where radio-tagged shad were confirmed to be present. Field crews were vigilant in looking for splashing activity in attempts to locate active spawning but no definitive spawning aggregations were observed. As noted in the comment, shad eggs do drift downstream following spawn. As a result, the revised study report will include identification of the likely spawning locations based on back-calculated upstream distances determined using egg stage derived from accepted laboratory criteria (and corresponding age in hours) and river velocity information taken at the time of sampling.
15	21	FWS	Since eggs were only collected at 30 percent of the sampling locations, the results do not demonstrate that spawning was widespread (and as noted above, collected eggs do not necessarily come from the sampling location). Since sampling was not randomly distributed across all habitat types, but only occurred at locations where tagged shad were tracked, there is no data to support the statement that the entire study reach is suitable for spawning.	We note that there were 60 sampling locations (with 2 trawls each, totaling 120 trawls/collections) and that eggs were collected at 31 (51.2%) of those locations. The statement in the initial study report was intended as a generalization based on the geographic distribution of egg collections as well as habitat types in the vicinity of those collections and estimated spawning locations. The revised study report will include a more detailed analysis on estimated spawning locations. We also note that the approved study plan did not include a randomized sample design.
16	21	FWS	According to the Revised Study Plan, observed effects of project operations on spawning activity were to be classified into three categories: (1) no effect; (2) moderate effect; and (3) adverse effect. "Moderate	The comment is noted. The study plan presumed that we would be able to observe some distinctions in spawning activity under different conditions which may have been apparent enough to categorize.

Comment #	Study #	Source	Comment	Response
			effect" was defined as "Observable possible effect on normal spawning activity: spawning may have been hindered but eggs were collected." Notwithstanding our question above about asserting that spawning occurred at a specific site based only on the collection of eggs, splashing was not identified at most locations and therefore spawning was only assumed based on a tagged fish presence. Without actual observations or data on actual spawning activity, it is not clear how "moderate effect" could be determined.	However, we recognized that these distinctions could not be predicted in advance since we did not know a priori what we would find and under what conditions. Since for the most part we were unable to observe actual spawning, such distinctions were unable to be made and this analysis could not be completed.
17	21	FWS	It does not appear that any directed testing of operational impacts was conducted; ichthyoplankton samples were collected irrespective of whether the project was generating or not. It was the Service's understanding that on/off multi-unit testing (as was done downstream of the Turners Falls Dam) or a similar methodology would be used to determine if generating conditions influenced spawning behavior.	Regardless of the study design employed downstream as part of the FirstLight study, we note that on/off multi-unit testing was not part of this study design or the approved study plan. Due to the distances and travel times of flows, multiple operational scenarios (i.e., combinations of 10 units operating or not) and size of the potential spawning habitat sample, this type of testing would be impractical. As noted above, the presence of splashing associated with spawning activity was not nearly as readily observed in the vicinity of the TransCanada projects as it was farther downstream in the FirstLight study.
18	21	FWS	From figures 6.3-1 and 6.3-2, it is difficult to actually tell what river flow was during each survey event, but Table 5.6-1 clearly shows that only one collection per site was made, which does not allow for comparing spawning behavior under different sets of conditions (at a specific site). In addition, because flows were unusually high in June of 2015, there were relatively few times when only the minimum flow was being released during the study, adding to the difficulty of discerning potential	The revised study report will provide a summary of project operations at the time of sample collection. We acknowledge that there were periods of spill during the spawning surveys; however, periods of minimum flow typically occur only rarely in the spring. Monthly flow exceedance curves from 1979 – 2015 indicate that minimum flows at both projects occurred on average, no more than about 1% of the time during June.

Comment #	Study #	Source	Comment	Response
			impacts that typical peaking operations may have on spawning. Figures 6.3-1 and 6.3-2 show overall discharge at Bellows Falls and Vernon relative to station capacities, as well as dates when spawning was or was not observed. Based on those figures, it appears that 12 of the 21 surveys downstream of Bellows Falls Dam and four of nine surveys downstream of Vernon Dam took place under spill conditions. So, essentially half of the data collected does nothing to inform potential project impacts.	
19	21	FWS	Given the level of information collected by TC, the Service does not believe an acceptable project-effects analysis on shad spawning can be completed. However, similar to our response to FL's report, we will postpone a decision as to whether the study should be redone or not until we receive the final Instream Flow report, as the habitat persistence analysis for shad spawning that will be undertaken as part of that study may be sufficient to determine project effects. Notwithstanding our position on this issue, we do request that TC add discharge/operational data to Appendix C or D.	Study 9 – Instream Flow Study will provide additional information to sufficiently assess project effects on shad spawning. The revised study report will include discharge /operational data, and we note that this data was also provided in Excel format via email to FWS on September 6, 2016.
20	21	NHFGD	[Page 55 of the study report states] "Upstream Fish Passage Effectiveness was calculated to be 51.0% overall which falls within the range (40-60%) of the management objective in the Connecticut River Atlantic Salmon Commission (CRASC) management plan for shad in the Connecticut River (CRASC, 1992)"… The low passage rate of tagged fish in this study compared to the overall passage rate relative to	We acknowledge that the reference to the CRASC management plan was misapplied. The revised study report will correct that and present values for the three fishway performance metrics detailed in the study plan: nearfield attraction, entrance efficiency, and internal efficiency. As with all clupeid tagging studies, a proportion of individuals are always expected to experience

Comment #	Study #	Source	Comment	Response
			Turners Falls suggests that there may have been some negative effects experienced by shad during the tagging process. Knowing the total number of First Light tagged American shad recorded as passing the Turners Falls Dam, compared to the 104 shad that were recorded at the Vernon Dam in this study, would be helpful in evaluating the passage success of different release groups.	tagging/handling effects which are usually expressed in the form of fallback (i.e., movement downstream and away from the study area following tagging). In addition to the metrics above, the revised study report will provide the proportion of tagged fish originally passing at Turners Falls which were subsequently detected at Vernon.
21	21	NHFGD	The average time between detection at the tailrace and detection at the attraction flow was 2.5 days. Median time was over 20 hours. This suggests some difficulty in locating the fishway entrance. It cannot be determined from this study whether shad "lacked the predisposition" to continue upstream. It is equally possible that fish were motivated to go upstream, but had difficulty locating the entrance to the fishway. Residence times of fish recorded in the tailrace, but not in the attraction flow, should also be reported. The presence of fish downstream should not be considered evidence of successful spawning or lack of predisposition to move upstream.	We agree that we don't know for certain about any individual's motivation to continue upstream or not. The statement about lack of predisposition was based on the following observations: a large proportion of released fish never approached the Vernon study area, spawning was observed in both the TC and FirstLight studies below Vernon, eggs were collected in that reach, and extensive spawning habitat is known to be available in the Turners Falls impoundment.
22	21	NHFGD	The statement that most shad passed through the fish pipe is technically correct, but somewhat misleading. The primary goal of downstream passage at a hydroelectric project is to encourage fish to not pass through the turbines. In this study, if you exclude the 5 fish for which passage route could not be determined, 19 fish passed through turbines and 20 fish passed by way of the fish pipe or the spillway. Therefore just fewer than 50% of the fish in this study took an undesirable route through the project on their way downstream.	The comment is noted and while we agree agencies typically prefer non-turbine passage routes over passage routes, overall passage survival is the critical metric to determining impact on migration and will be evaluated in the revised study report. See also response to comment # 10.

Comment #	Study #	Source	Comment	Response
23	21	VANR	The analysis was not carried out in a manner that would allow the goals of the study to be met. The analysis to characterize behavior, approach routes, passage success, survival and residency time by adult American shad in the context of project operations is simplistic and does not adequately inform the Agency of the role and interplay between changing variables including operational turbine discharge, turbines used, spill (ranging), diel period (AWS set on/off – operational), on ladder attraction, entry attempts, and subsequent passage and later downstream route, residency (delay), and survival/fate.	The comment is noted, and the revised study report includes additional data and analysis as outlined in Attachment 1 to TC's August 31, 2016 filing of the August 25, 2016 study meeting.

Study 25 - Dragonfly and Damselfly Inventory and Assessment

Comment #	Study #	Source	Comment	Response
1	25	VANR	While the study report analyzed the effects of project operations through water-level fluctuations on habitat availability and the potential for direct mortality from rapidly rising water from project operations, it does not analyze species differences in vertical and horizontal distance from the edge of water with water level fluctuation observed at each site. Completion of this analysis would provide information on the potential vulnerability of a species to water level fluctuation from project operations. Additionally, the analysis may potentially provide further information on the presence, absence or low abundance of a species at a site. The Agency recommends that range of vertical and horizontal distance travelled by each species be	Vertical distance travelled was analyzed to the extent possible (p. 16). The report will be revised to include an analysis of horizontal distance travelled.

Comment #	Study #	Source	Comment	Response
			analyzed in the report.	
2	25	VANR	Section 4.4 Field Surveys – The report and datasheet state that, "For each specimen identified, species, life stage (larva, eclosing, exuvia, or teneral), surface the specimen was found on, and vertical and horizontal distance from the observed water line were collected." The report does not present information related to the surface or substrate that the specimens were found on and whether the substrate used by species differed. The Agency requests that this information be presented and analyzed in the report.	The report will be revised to present eclosion substrate data.
3	25	VANR	Section 4.5 Habitat Assessment – The reports states, "For each transect, the following habitat characteristics were estimated: bank height, steepness, and relative stability; percentage of the bank consisting of bare substrate, vegetation, and other cover; and percent canopy cover." The habitat data is not presented in the report. The study evaluates the potential project effects of project operations on habitat yet it does not provide a summary of habitat parameters measured in the study. The Agency requests this information be included in the report.	The report will be revised to include a table of habitat parameters.
4	25	VANR	Section 5.3 Habitat and Eclosion Behavior – The section presents species information on the vertical distance traveled, and a limited comparison to other odonate species. The Agency recommends that a comparison of the vertical distance traveled from the water surface	The report will be revised to include the requested box plot containing the vertical distances from the water surface of specimens.

Comment #	Study #	Source	Comment	Response
			between species should be presented graphically, preferably in a box plot.	
5	25	VANR	Section 5.3 Habitat and Eclosion Behavior - The final paragraph of this section states, "Although horizontal distance of exuviae from the water surface was measured in the field, it was found to be of limited use. Because of the non- uniform nature of the bank profiles and the non-linear path frequently observed for emerging larvae, the actual horizontal distance travelled could not be determined unless the individual was tracked from emergence from the water to its eclosion location." The Agency agrees that it is not possible to know the exact horizontal distance an individual traveled during emergence do to the reasons listed in the report. However, the distance travelled for some odonate species has been recorded by other studies (Morrison et al. 2006; Martin 2007; Martin 2010). A comparison to observed horizontal distance travel for odonate species to the distances recorded by other studies should be conducted.	We note that Martin (2007) and Martin (2010) do not distinguish between odonate larvae and exuviae. Morrison (2006) only recorded the linear distance travelled rather than horizontal or vertical distance, and thus that information cannot be compared to the data collected in this study.
6	25	VANR	Section 6.1 Habitat Inundation – The report states, "Appropriate habitat for odonates consists of fine aquatic substrates (sand and silt) for larvae with nearby steep, sparsely vegetated banks for eclosion. There is potential for habitat needed during the critical emergence period to be unavailable when the entire bank height becomes inundated." The report only generally defines the 'appropriate habitat' and does not provide a quantitative measure to determine how the maximum and minimum elevations of habitat were	The report will be revised to include a more detailed explanation of how appropriate habitat was defined, and the importance of appropriate habitat to odonates. As discussed in the Section 5.3 and 5.4, habitat quality appears less important for odonates than the timing of water level fluctuations during the critical emergence period.

Comment #	Study #	Source	Comment	Response
			determined for the inundation analysis. Additionally, in Section 5.3 the reports states that "Transects with few or no odonate observations were widely variable in all habitat characteristics and no consistent trends were found. No specific habitat characteristic appeared to be a good predictor of odonate abundance" If habitat was not determined to be a good predictor of odonate abundance, is it the appropriate variable to assess in terms of the project effects on odonates? The Agency requests that additional information be provided on how the minimum and maximum elevation of available habitat were defined and why habitat was used to assess project effects. Additionally, the Agency requests additional analysis of how other variables collected during the field study, such as substrate or vertical height of the species from the water are affected by project operations.	

Study 26 - Cobblestone and Puritan Tiger Beetle Survey

Comment #	Study #	Source	Comment	Response
1	26	VANR	Section 6.2 Assessment of Project Effects on Adults – This section analyzed the effects of normal project operations on adult cobblestone tiger beetle habitat for the five model years as the percent of days the habitat range (maximum and minimum elevation) is inundated. The Agency recommends that the proportion of adult cobblestone tiger beetle habitat affected in general by	We analyzed the data for percent of days with partial or full inundation using the limited elevation data obtained at some points at each site. Those elevation points were used to estimate the upper and lower habitat elevations to which we compared modeled WSEs. Examination of the proportion of total habitat at

Comment #	Study #	Source	Comment	Response
			project operations from the five model years be examined and included in the report.	each site that may be project affected at different WSEs would require detailed topographic surveys of the full extent of each study site, which was beyond the scope of the approved study plan. We note that analysis of the upper 25% of the habitat range was based on a vertical assessment of habitat only.

Study 32– Bellows Falls Aesthetic Flow Study

Comment #	Study #	Source	Comment	Response
1	32	VANR	The Agency appreciates the collection of additional field data that has been incorporated into the report consistent with the Revised Study Plan. The additional video provides valuable data to evaluate compliance with the Aesthetics management objectives and criteria of the Vermont Water Quality Standards. The Agency notes that dependent on the results of the instream flow study and pending a bypass flow proposal, it may be necessary to evaluate an additional flow for aesthetics at a later date, if the Agency could not make a positive finding in regards to aesthetics on each flow bracketing the proposed bypass flow.	The comment is noted.